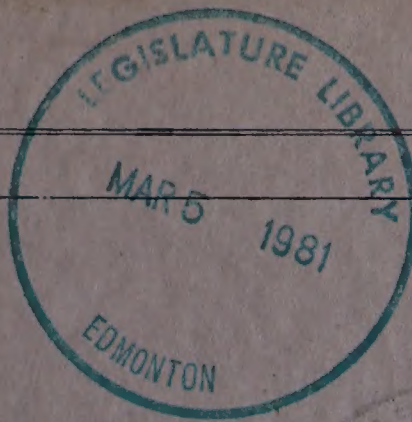


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Sept 24/51
V019



The Province of Alberta

PETROLEUM AND NATURAL GAS CONSERVATION BOARD

IN THE MATTER OF THE GAS RESOURCES PRESERVATION ACT

AND IN THE MATTER of a Joint Hearing to determine various questions
relating to the proposed Export of Natural Gas from the Province of Alberta.

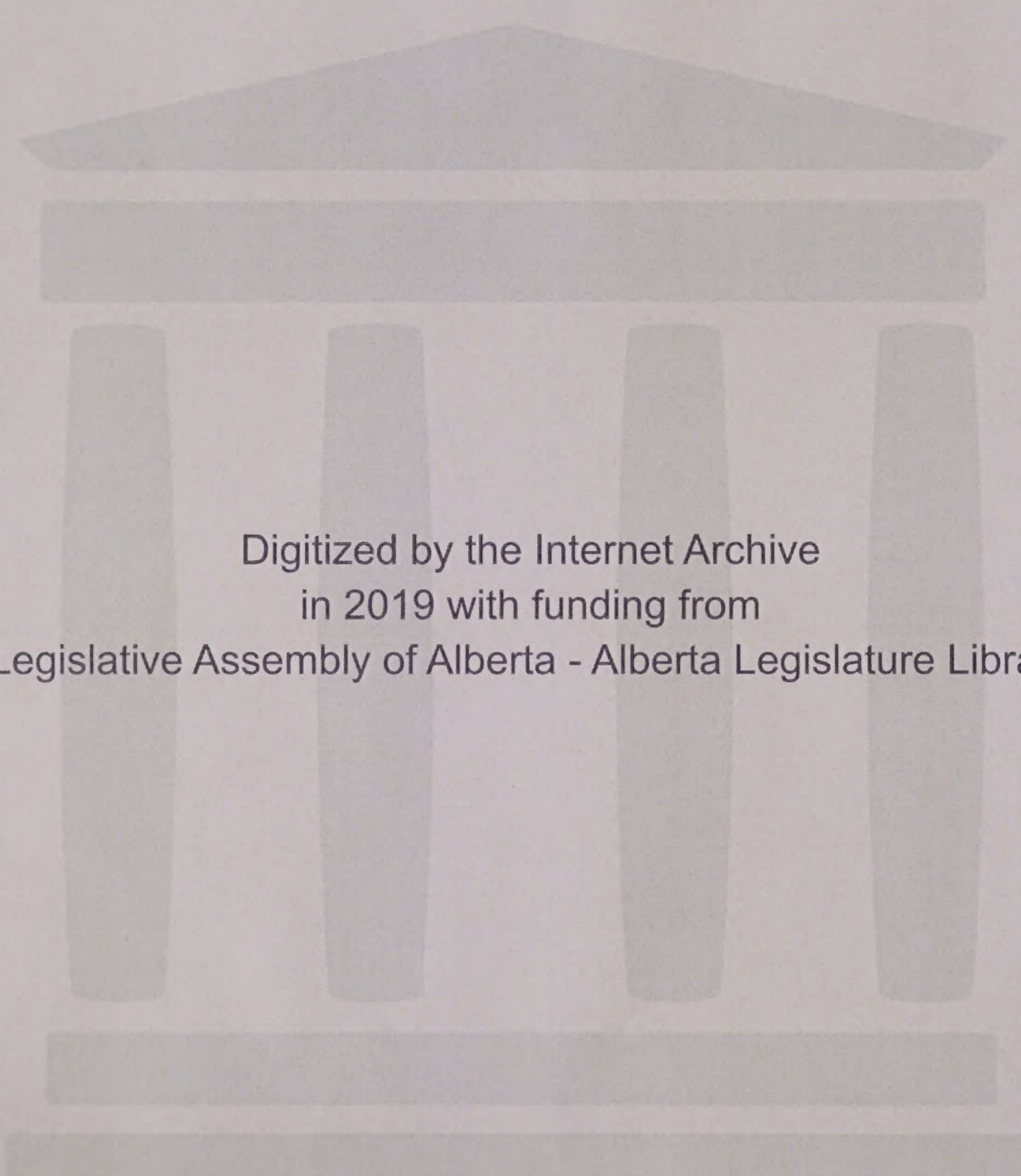
I. N. McKinnon Esq., Chairman

D. P. Goodall Esq.

Dr. G. W. Govier

Session: SEPTEMBER 24th, 1951.

Volume 9



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I N D E X

VOLUME 9.

24 September 1951.

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Statement of the Board.

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VOLUME 9.

September 24th, 1951.

THE CHAIRMAN: Before we ask Mr. Dougherty to proceed this morning, I would like to make a statement on behalf of the Board.

The Board has given further consideration to the question of hearing evidence related to matters other than those which are the subject of the present sittings and to the question raised some time ago by Mr. Martland in his letter of August 29, 1950, which is reproduced in the Board's Interim Report. We feel that a statement from us at this time would be helpful to the applicants and other interested parties.

Firstly, and to reiterate, it was the Board's desire, of which counsel were informed, to hear both supplementary and new evidence at the present sittings on:

- (2) reserves of gas within the Province
- (b) present and future provincial requirements
- (c) present and future deliverability of gas

and the manner in which the applicants propose that the provincial and the export requirements may be met.

We have now decided that we would like, at a later sitting, to hear further evidence relating to contracts, export markets, routes, and costs. The Board is prepared to continue the present sittings until all pertinent evidence has been presented and then to adjourn to a later date and hear other evidence. It is our thought that time might be provided at the start of

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1911

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Statement by the Board

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the second sitting for applicants or others to submit supplementary information related to matters now being heard. The primary purpose of the second sitting, however, would be to hear supplementary and new evidence on:

(a) applicants' ownership of gas and applicants' contracts to purchase or otherwise acquire property in gas within the Province. This information should be given for individual fields or pools and should indicate whether the gas is controlled by virtue of ownership, lease, contract or option agreement. The Board is prepared to recognize option agreements made contingent upon the applicant being granted a permit and upon the Board designating all or part of the production from a field or pool as being surplus to the present and future needs of the people of the Province. We anticipate that all contracts and option agreements will include details concerning the price to be paid to the producer.

(b) the marketing areas to be served outside the Province and the breakdown of the annual and peak-day export requirements among domestic, commercial, firm industrial and interruptible industrial consumers for the initial and each fifth year of the period of the proposed export.

(c) the location, layout, design and capacity of the gathering system and the transmission system proposed. While the Board wishes full details for those portions of the system within the Province, lesser detail will suffice for the portions outside the Province.

The second finding is that the Board has not adequately considered the interests of the community in its decision-making process. The Board's actions have been primarily self-serving and have not taken into account the needs and desires of the community.

(a) The Board's actions have been primarily self-serving and have not taken into account the needs and desires of the community. The Board has failed to consider the interests of the community in its decision-making process. The Board's actions have been primarily self-serving and have not taken into account the needs and desires of the community. The Board has failed to consider the interests of the community in its decision-making process. The Board's actions have been primarily self-serving and have not taken into account the needs and desires of the community. The Board has failed to consider the interests of the community in its decision-making process.

(b) The Board's actions have been primarily self-serving and have not taken into account the needs and desires of the community. The Board has failed to consider the interests of the community in its decision-making process. The Board's actions have been primarily self-serving and have not taken into account the needs and desires of the community. The Board has failed to consider the interests of the community in its decision-making process.

(c) The Board's actions have been primarily self-serving and have not taken into account the needs and desires of the community. The Board has failed to consider the interests of the community in its decision-making process. The Board's actions have been primarily self-serving and have not taken into account the needs and desires of the community. The Board has failed to consider the interests of the community in its decision-making process.

Statement by the Board

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(d) the estimated capital costs of the proposed gathering system and the transmission system together with estimates of the gathering and transmission costs per thousand cubic feet of gas.

Upon the completion of the present sittings the Board presently intends to adjourn to October 22nd, but would like counsel to give us their views with regard to this date.

(Go to page 715)

(2) The estimated value of the property
estimated system and the estimated value of the system
with relation of the estimated and estimated value
for the estimated value of the system.

Under the supervision of the present system, the
board has been in contact with the system and
the system has been in contact with the system and
regard to this case.

For the year 1951

J.F.Dougherty,
Cr.Ex. by Mr.Steer.
Cr.Ex. by Mr. S.B.Smith

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JACK F. DOUGHERTY, recalled, already sworn, testified as follows:-

MR. PORTER: Are all counsel through with Mr. Dougherty?

MR. STEER: There is one question I would like to ask Mr. Dougherty and get his answer, if I may, sir?

THE CHAIRMAN: Yes.

.....

CROSS-EXAMINATION BY MR. STEER:

Q My question is as to whether or not you have the sand thickness of Viking-Imperial-Legal wells Nos. 1 and 2?

A Yes, sir. In the Viking?

Q In the Viking sand, please?

A We estimate that the thickness of net Viking gas sand in Imperial-Legal No. 1 is 12 feet, having 10 feet, and Imperial-Legal No. 2 12 feet.

Q That is all, thank you.

MR. S. B. SMITH: I have a few questions.

.....

CROSS-EXAMINATION BY MR. S.B. SMITH:

Q Mr.Dougherty, I was discussing with you the other day the question of the increase in the reserves of Alberta since January 1st, 1951, you will recall?

A Yes, sir.

Q And, according to the first sheet in your Volume 3, the changes in your figures between April 15th, 1951, and August 1st, 1951, are plus 529 billion, 943 million?

J. F. Dougherty,
Cr. Ex. by Mr. S. B. Smith.

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A That is correct.

Q And the changes are made by, according to your evidence, particularly of changes due to arithmetical computations, partly due to changes in arithmetical computations and partly due to new added reserves?

A Or revisions in reserves previously estimated.

Q Or revisions in reserves previously estimated?

A Yes.

Q And you went over that in some detail with Mr. Porter, and I think it is possible from the evidence you gave to take that 529 billion and break it down into the portion that is due to arithmetical computation, the portion that is due to new discoveries, and the portion that is due to new computations of old discoveries, that can be done?

A Yes, sir.

Q So that your figure of 529 billion does then include some reserves discovered since January 1st, 1951?

A Yes, sir that is correct.

Q Now, at page 579 of the transcript, you told me, as I understood your evidence, and I have it in front of me, that it would be a relatively simple matter for me to pull out, this is your own language, and make a computation of my own of the increases in the reserves since January 1st, 1951, because, in your own words "All of the fields are set up by dates" on these sheets, or dates of discoveries, you recall saying that?

A Yes, that is correct, particularly for new discoveries.

Q Well, now, Mr. Dougherty, I have done, so far as I can do, what you suggested that I do, and I went, for instance, to



J. F. Dougherty,
Cr. Ex. by Mr. S. B. Smith

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Census Division 1, and you will find, according to the dates in Census Division 1, the first sheet, New Discovery Dates, I believe, no 1951 Discoveries?

A Well, sir . . .

Q And equally you will find none in Division 2?

A There is a discovery in 1951 with insufficient data to estimate it.

Q I am only taking the figures where there is gas available on your figures. We go to Census Division No. 3, and the only one by which we find gas available, I think is, - excuse me just for a moment. It is Steveville North, and on page 3, in Census Division 3, 2529, that is the only item there I find in 1951, with gas available. Is that correct?

A Yes, sir.

Q I do not want to take the time to go through all of these Census Divisions, but I have gone through, and if my extractions are correct, and if my addition is correct, I find that proceeding on the basis upon which you suggested, I could proceed to pull out of 1951 discoveries, I get a total of 174 billion, 837 million cubic feet. Now, you would not suggest that there have been only discoveries, new discoveries, since January 1st, totalling 174 billion feet, would you?

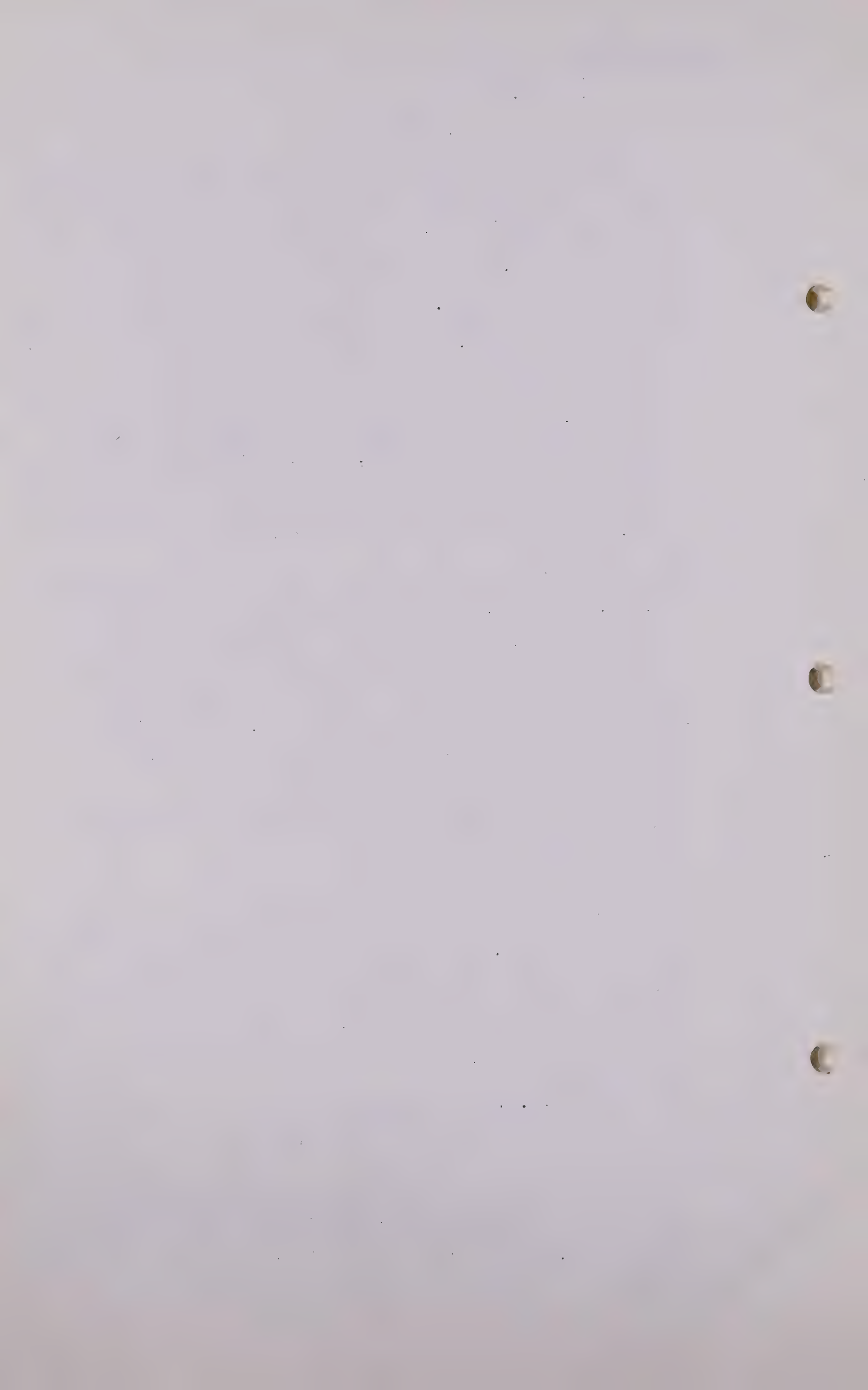
A That is correct.

Q Now, am I correct in my present suggestion to you that you cannot by following the procedure suggested by you ascertain the amounts of the discoveries on your computation since January 1st, 1951?

J.F.Dougherty,
Cr. Ex. by Mr. S. B.Smith

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- A According to our computations that is essentially correct. This is the difficulty, the closer you are to a discovery date of a field, the poorer the information and the less the reserve estimates. If you are now looking at 1951 discoveries in 1955, the difference would be quite marked. I think there will be additional discussions by Mr. Trostel on new fields, from which data has become available in greater amount during the last month, involving revisions and additions to areas in Census Divisions 15 and 16 particularly, which will amplify the figures you are attempting to arrive at.
- Q Now, Mr.Dougherty, what I want to get at at the moment is that the suggestion you make now at page 579, or the suggestion you made to me at page 579 that I could extract the discoveries since January 1st, 1951, which procedure apparently leads to a total of 174 billion feet, is really not a sound approach, is it?
- A It is all the approach that can be made at this time.
- Q From your report?
- A Yes, sir.
- Q Now, for instance, you go to Census Division 3 in Medicine Hat, and you show the discovery dates of Medicine Hat as varying, running between 1890 and 1926, so that according to the face of the report that is an old discovery?
- A Fundamentally. . .
- Q May I just finish my question to you?
- A Yes.
- Q But actually there is a substantial new discovery in Medicine Hat, consisting of the Britalta wells which are of some substance?



J.F.Dougherty,
Cr. Ex. by Mr.S. B.Smith

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A That is correct.

Q But on the basis of your report that is not apparent?

A Yes, that is true, but fundamentally. . .

Q So that . . .

A May I finish that?

Q Yes?

A Fundamentally, an extension of a field is not a discovery.

Q I quite understand that.

A It is customarily referred to the date of the discovery of the field, since it is merely an enlargement of the knowledge of the reservoir. That is the system usually applied by the American Petroleum Institute and by the American Gas Association and by ourselves in summarizing reserves.

Q I am not criticizing you in any way, Mr.Dougherty.

A Oh, I quite realize that.

Q I am just endeavouring to ascertain facts. So that we have a figure here of 174 billion according to the face of your report with regard to discoveries since the 1st of January, 1951, which you concede is very considerably low.

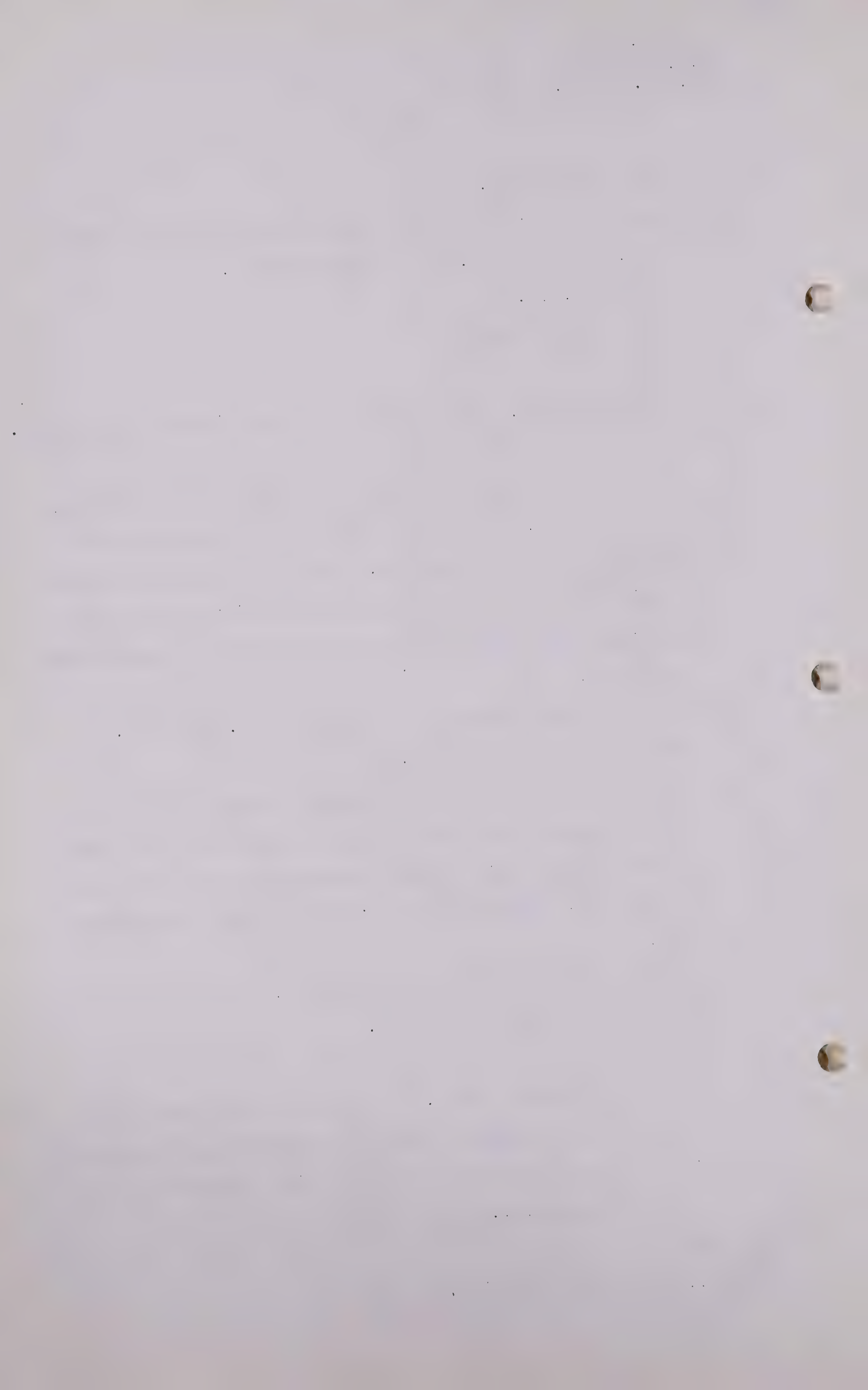
A On the basis of absolute discoveries, that is correct with the information to date.

Q Yes?

A In connection with this, the total we have shown there of some 529 billion was actually fundamentally increased in the reserves due to revisions which occurred in the last six months....

Q Yes?

A ...and new discoveries.



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Cr. Ex. by Mr.S. B. Smith

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Q But your 529 billion included some arithmetical corrections?

A Oh, about less than 1% in volume.

Q Less than 1%?

A Yes.

Q So that your 529 billion really is a portion of the increase in the reserves since January 1st, 1951?

A That is correct.

Q But not all of them?

A Yes.

Q So that I am correct in my suggestion to you that you cannot follow the procedure that you suggested the other day, and measure the reserves ascertained since January 1st by extracting them, pulling them out, in other words, based on the discovery dates?

A My impression was that you were interested in new discoveries, that is essentially true.

Q That is essentially true?

A Yes. Now, as to revisions of old fields, of course, it is more complex than that.

Q That is very much more complex, but you would not suggest that 529 billion less the arithmetical corrections, is the limit of the discoveries since January 1st, plus additions by reason of the increase in the old reserves?

A That is the limit of our ability to calculate it at this time.

Q Since April 15th?

A Yes.

Q But you have not computed them for, say, January 1st, between January 1st and April 15th?

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Cr.Ex. by Mr. S. B.Smith

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A This is a close approximation.

Q This is a close approximation?

A Yes, there is very little difference.

Q There is very little difference?

A Yes, because that is a little arbitrary in the sense that the information which would be required to estimate additional reserves or extensions of fields or new discoveries, would be available for a six-month or a year period, so that there is a time lag in what you are going to refer your estimate to.

Q Yes?

A I doubt if you could get any two people to agree on the precise data on which a revision or an extension should be assigned.

Q I quite agree with you, but if you wanted to compare your estimate as of January 1st, 1951, for instance, with the estimates made by this Board in its Interim Report, then you have to take into account various increases made by you, such as in Pincher Creek, Princess, Cessford, Viking-Kinsella and all of those various increases that you have provided for, but it would be difficult to make that comparison because your approach and your computation are in a somewhat different manner?

A I think that is probably true.

(Go to page 722)

J. F. Dougherty,
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Q At the moment, then, we have no means of comparing or fixing exactly the amount of the increases since January 1st in the reserves of Alberta by reason of new discoveries plus your computations or re-computations of the increases in old reserves plus straight re-computations such as you have made in some fields?

A No, you can only approximate that because of the difficulty of assigning the date at which extension occurred.

Q You have not approximated that?

A No, we have not.

Q MR. PORTER: Mr. Dougherty, I want to bring your attention to a question Mr. Steer asked you at page 703 of the record in connection with the chart which I see still remains on the blackboard. If the Board has copies they can see the question, otherwise I will read it.

MR. S. B. SMITH: What page, Mr. Porter?

Q MR. PORTER: Page 703.

"Q. Dealing with this diagram you have on the board, Mr. Dougherty, is this a possible suggestion that your volumetric estimate would give you more than a trillion feet and the pressure decline against production method would give you less than half a trillion feet?

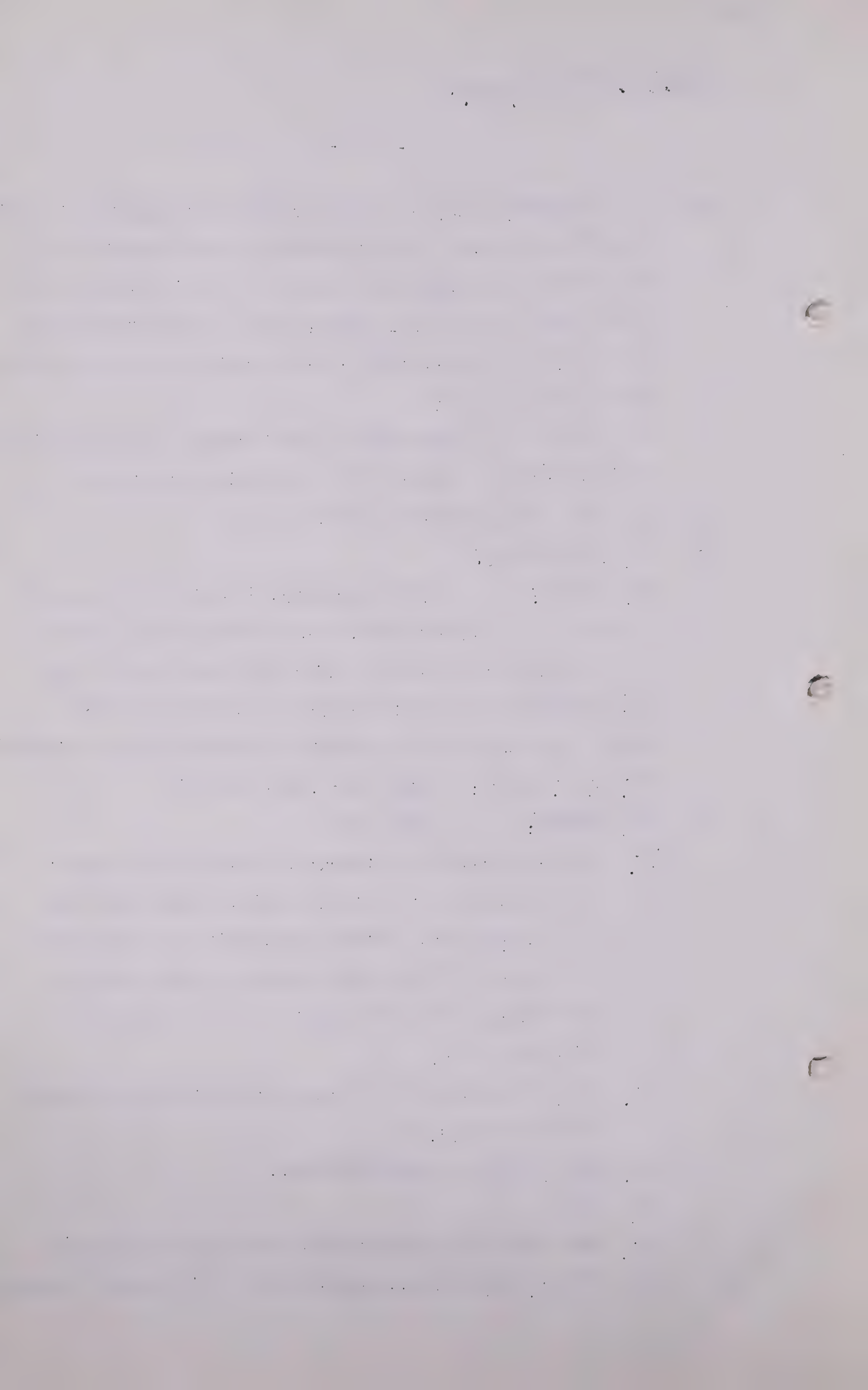
A. Oh, I can conceive of the factors being so arranged that it could, yes.

Q. Well, that is a possibility?

A. Yes.

Q. What would your explanation be of that situation?

A. Well, I would accept pretty well the pressure decline.



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"If I found that situation I would assume that there was considerable lack of knowledge in one or more of the factors that did not balance out in the volumetric estimate. Again, it is the function of weighting, as to the effect from the data with regard to some of the variations that those assumptions would make. It would take a relatively large variation in either thickness or connate water saturation to throw your volumetric calculation away off, and normally, if you have selected, say, the cream of the gas sand, the highest permeability and the highest porosity, your connate water saturation will be low, therefore, the acre-feet of pore space is partially compensated for by the reduction in the connate water saturation. By the same token, if you take a wider thickness of sand, a greater thickness of sand, including lower permeabilities, your connate water saturation would be increased in proportion, not directly such that it would tend to pull down the acre-feet of the pore space. So that does take some very wide differences in large areas, wide differences in basic assumptions."

Now, I call that to your attention for the reason that in the preceding pages of your testimony with respect to it, about the lines, the half trillion and the trillion, a line on this chart, you had been talking about the reasons why the half trillion line was wrong. Now have you any comment to make about that question, which I am afraid, standing by itself, might be a contradiction

J. F. Dougherty,
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E. G. Trostel,
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of all of your evidence and be misunderstood.

A Again that might be a possibility, if taken out of the context. However, I think the previous discussion demonstrated to our satisfaction that the half trillion reserve would be the absolute minimum and could not stand on its feet in view of the changes in pressures that have occurred during the period 1945-1950, that an estimate of reserves in the order of 670 billion to 500 billion is based upon the erroneous pressure production relationship based upon the area under drainage in 1945, which is now considerably larger, and as that discussion indicated, the range of the data as we see it in 1951 is in the realm of 1 trillion-plus cubic feet, as the best pressure decline relationship available for Viking-Kinsella, so that there is no possibility of the 500 billion feet as being a realistic figure with the data as of 1951.

Q I do not have any more questions.

THE CHAIRMAN: Is Mr. Trostel-available?

MR. PORTER: Yes.

EVERETT G. TROSTEL, recalled,

already sworn, examined by Mr. Porter, testified as follows:

Q Mr. Trostel, as I remember it, we did not put Volume 4, your compilation, in evidence when you were on the stand the other day, nor did we put in at that time two charts, one showing deliverability and the other showing the rate of discovery, and I think at this time it might be well to have you identify them so that they will all be before us when you are testifying. I now tender Volume 4 of the

E. G. Trostel,
Dir. Ex. by Mr. Porter.

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Composite Projection of the Estimated Future Availability
of Natural Gas for the Province of Alberta, as of January
1st, 1951.

COMPOSITE PROJECTION OF THE ESTIMATED
FUTURE AVAILABILITY OF NATURAL GAS
FOR THE PROVINCE OF ALBERTA AS OF
JAN. 1, 1951 MARKED EXHIBIT 23.

MR. MAHAFFY: We could not hear the private
conversation Mr. Porter was having with his witness. What
was put in and what was the number assigned?

THE CHAIRMAN: Estimated Future Availability of
Natural Gas, and is Exhibit No. 23.

MR. PORTER: And I tender two charts, one
showing the rate of discovery in the Province over a period
of years and the other showing the deliverability of the
reserves as estimated by DeGolyer and McNaughton over a
period of years on the assumption that the needs of the
Province and the requirements of Trans-Canada are both
taken care of under the deliverability schedule.

THE CHAIRMAN: Are they the one exhibit,
Mr. Porter, or the rate of discovery 24 and deliverability
25?

MR. PORTER: I think that would be more
satisfactory. There is a table in the chart on the
deliverability subject that might be marked together.

THE CHAIRMAN: I beg your pardon?

MR. PORTER: There is a table and a chart on
deliverability that perhaps should be marked together.
They go together.

E. G. Trostel,
Dir. Ex. by Mr. Porter.

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RATE OF DISCOVERY MARKED
EXHIBIT 24.

CHART MARKED EXHIBIT 25.

TABLE OF FIGURES SUPPORTING
CHART MARKED EXHIBIT 25A.

MR. PORTER: Perhaps I should go over that again, counsel have not heard it. The chart showing the rate of discovery . . .

MR. STEER: Is that a record of initial recovery gas reserves?

MR. PORTER: Very well, sir.

MR. STEER: As Exhibit 24?

Q MR. PORTER: And 25 is the deliverability chart and 25A a table to be attached to it and will be read with it? Now, Mr. Trostel, these exhibits which have just gone in the record were all prepared under your supervision?

A That is correct.

Q Mr. Chairman, inasmuch as there seems to be some confusion about the basis on which this presentation was being made, as it developed in discussions with Mr. Dougherty, and some doubt about why the material was divided as it has been, I have decided that for the purposes of the record it would be well to have Mr. Trostel outline the assignment that was given to his firm by my clients and the directions that were given by the Board as to the material which was to be submitted here, and I think that is necessary. It will take a few minutes but it does fit this stuff in where it belongs, having regard to the Board's instructions in their

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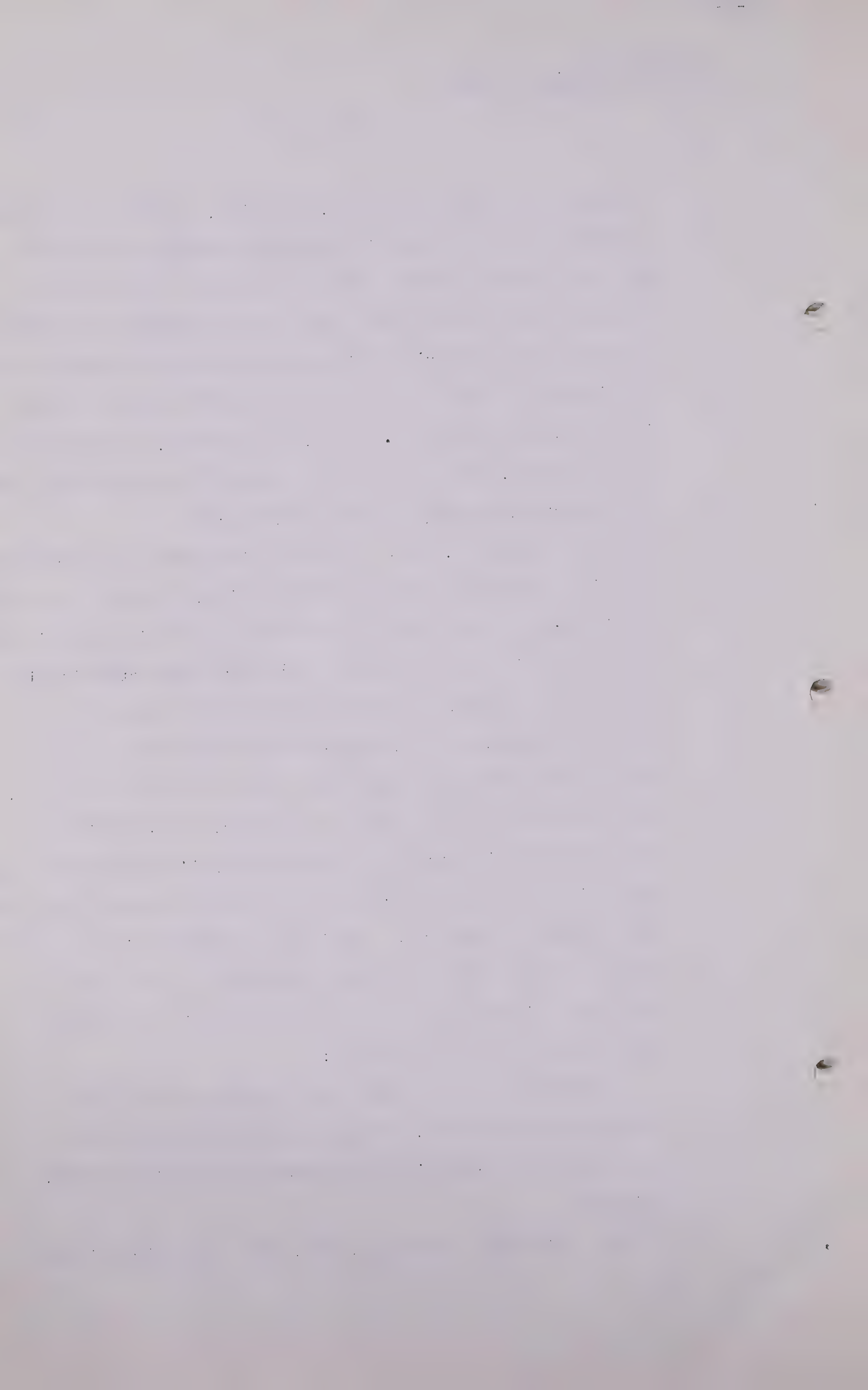
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letter of the 2nd of October, and will, I think, save some confusion in the future if everybody understands why it was put together in the shape in which it reaches us. I thought occasionally there was some misunderstanding about it by some of our friends in the course of Mr. Dougherty's testimony. I think we had better have Mr. Trostel clear it up and go on with it. Now, Mr. Tröstel, having heard those remarks, will you start in and outline for us the job you undertook and why it takes this form?

A I will be happy to, sir. When Mr. Dougherty announced to our firm last summer that he was leaving, would be leaving, and I found it necessary to get into our firm's operations on this particular assignment, I had the same question in my own mind to answer, that was, what exactly were we to do for our clients, and I learned I would find the answer to that in the letter from the Board under date of October 2, 1950, addressed to Mr. Frank A. Schultz, Vice-President of Canadian Delhi in regard to Canadian Delhi's application for permission to remove or cause to be removed natural gas from the Province of Alberta. If I may, I should like to read certain of the terms which were outlined by the Board and which our clients asked us to take care of in presenting their case. I read as follows:

" Relative to the application submitted with your letter of September 29, 1950, the Board requires that you furnish the following additional and detailed information."

It then lists many items (a), (b), (c). The first item



E. G. Trostel,
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which concerned us is item (b),

- "(b) The estimated reserves of gas for each pool, field or area within the Province, together with the complete description of each such pool, field or area and the pertinent geological and engineering data; reserve data to show gas in place, gross producible reserves to reasonable well head abandonment pressures, discounts (for processing shrinkage, lease, plant and field fuel, flaring and operational loss) and net gas available for disposition under the following categories:
- (i) Deferred on account of requirements for pressure maintenance or for other reasons having to do with the optimum recovery of oil or condensate.
 - (ii) Within economic reach of a market, pipe line or practical grid system.
 - (iii) Beyond economic reach of a market, pipe line or practical grid system.

I might say in answer to that particular section we have prepared exhibits which now have been placed in evidence, and in regard to the general geological data we have put into record isopachous maps covering fields in which some 95% of the total reserves which we have estimated occur. We arranged the fields in order of size and attempted to give full detail on all the important fields.

I might mention in regard to those maps that in the case of Turner Valley there is an exception. We felt there was a great deal of information already in the

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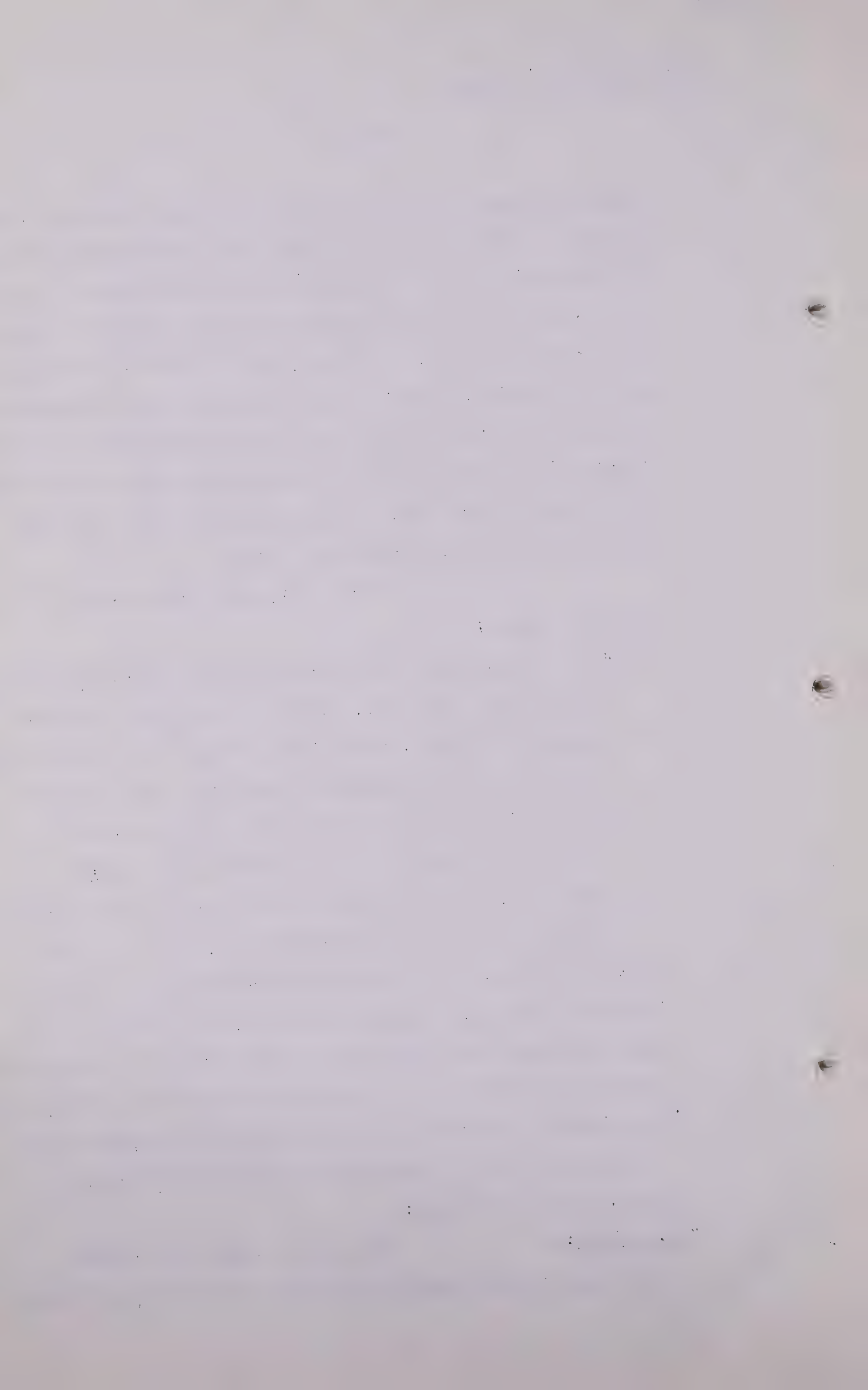
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record in regard to maps and areas, and as a matter of fact, we made our reserve and deliverability computations not on a volumetric basis but based rather on performance of the field, and hence the maps themselves were of little significance. There were, I believe, three other fields relatively new discoveries, on which we were unable to put isopachous maps into the record due to the fact that the source of our information requested that we not show any data concerning seismic work, core drilling and so forth, show that configuration in the record at this time.

Item (c), and this again is from the letter:

"(c) The Estimated present and future deliverability of gas from each pool, field or area within economic reach of a market, pipe line or practical grid system together with the pertinent geological and engineering data; these data to indicate the present and future deliverability for a typical well within each pool, field or area as well as the total deliverability for the fully developed pool, field or area;" That, as written, is a terrific assignment and so far as the amount of work, fortunately for us, the difficulty of that assignment was recognized by Dr. Govier in a discussion between Dr. Govier and Mr. Dougherty in the May hearing, and if you would like to read in that regard from page 210 and a portion of 211 of that hearing, the testimony given on May 10, 1951, as follows:

"DR. GOVIER: You mean to draw up a single performance chart weighted according to pressure, reserves, etc?"



E. G. Trostel,
Dir. Ex. by Mr. Porter.

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"ANSWER; Yes.

DR. GOVIER: For a group of fields?

ANSWER: Yes.

DR. GOVIER: I think that would be perfectly acceptable
to the Board, Mr. Dougherty?"

We take that to constitute a
modification of section (c), item (c), which I have just
read. Without taking that type of a combination, the job
would have been extremely complex. I should then like to
read item (e),

"(e) The manner in which the applicant proposes that
the present and future requirements of the Province
may be met from the existing reserves of gas showing
in detail and through a deliverability schedule how the
annual and peak loads may be satisfied for a period
of at least thirty years;"

And the fourth item which is item (1) of the letter:

"(1) The manner in which the applicant proposes that
the present and future requirements of the areas to be
served outside the Province may be met from the
existing reserves showing in detail and through a
deliverability schedule how the annual and peak load
requirements may be satisfied for a period of at least
twenty years;"

Those latter two requests require us to make a tentative
selection of reserves for fields to be assigned to Trans-
Canada. However, I believe that was pointed out by
Mr. Dougherty and I should like to reiterate that the
selection made was and is definitely tentative, that it is

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completely flexible. It is rather unfortunate, perhaps, to be in the position of assigning particular fields to a particular export system during the period in which reserves are still being found at a rapid pace. However, we made the selection as was required by the Board.

(Go to page 732.)



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And again, I say it is quite tentative and flexible.
I believe that briefs quite clearly an assignment which we had and in carrying out that assignment we have prepared the exhibits which have now all been tendered.

Q MR. PORTER: Now, with that explanation, will you turn to volume 3.

A Yes, sir.

Q I think you told us the other day that volume 3 brings up-to-date the fields dealt with in Exhibits 4 and 4-A?

A Yes, sir.

Q And that those extensions to fields previously dealt with in 4 and 4-A have been covered by Mr. Dougherty?

A That is correct, sir.

Q In Exhibit 10 there remain then some additional facts to be dealt with. Now, what are they, besides the extensions, what is in 10?

A Well, particularly, Mr. Porter, we have estimated, made an attempt to estimate the reserves of all fields possible in accordance with the request of the Board. Our Exhibits 4 and 4-A represented perhaps the cream of the crop, those that were given estimates that we could estimate most readily, and those fields whose reserves were the largest. In volume 3 we have estimated the reserves of an additional 45 reservoirs located in 36 fields which were not included in Exhibits 4 and 4-A.

Q An additional 45 fields?

A Yes, sir, an additional 45 reservoirs.

Q Regardless of the date of discovery?

A Yes, 45 reservoirs.

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Q 45 reservoirs?

A In 36 fields, regardless of the date of discovery. As a matter of fact, the great majority of these fields discovered some time back are relatively of minor importance in size, and we would have estimated them in Exhibits 4 and 4-A had there been time.

Q I see. They are added to the fields covered in volumes 4 and 4-A and are not necessarily new discoveries?

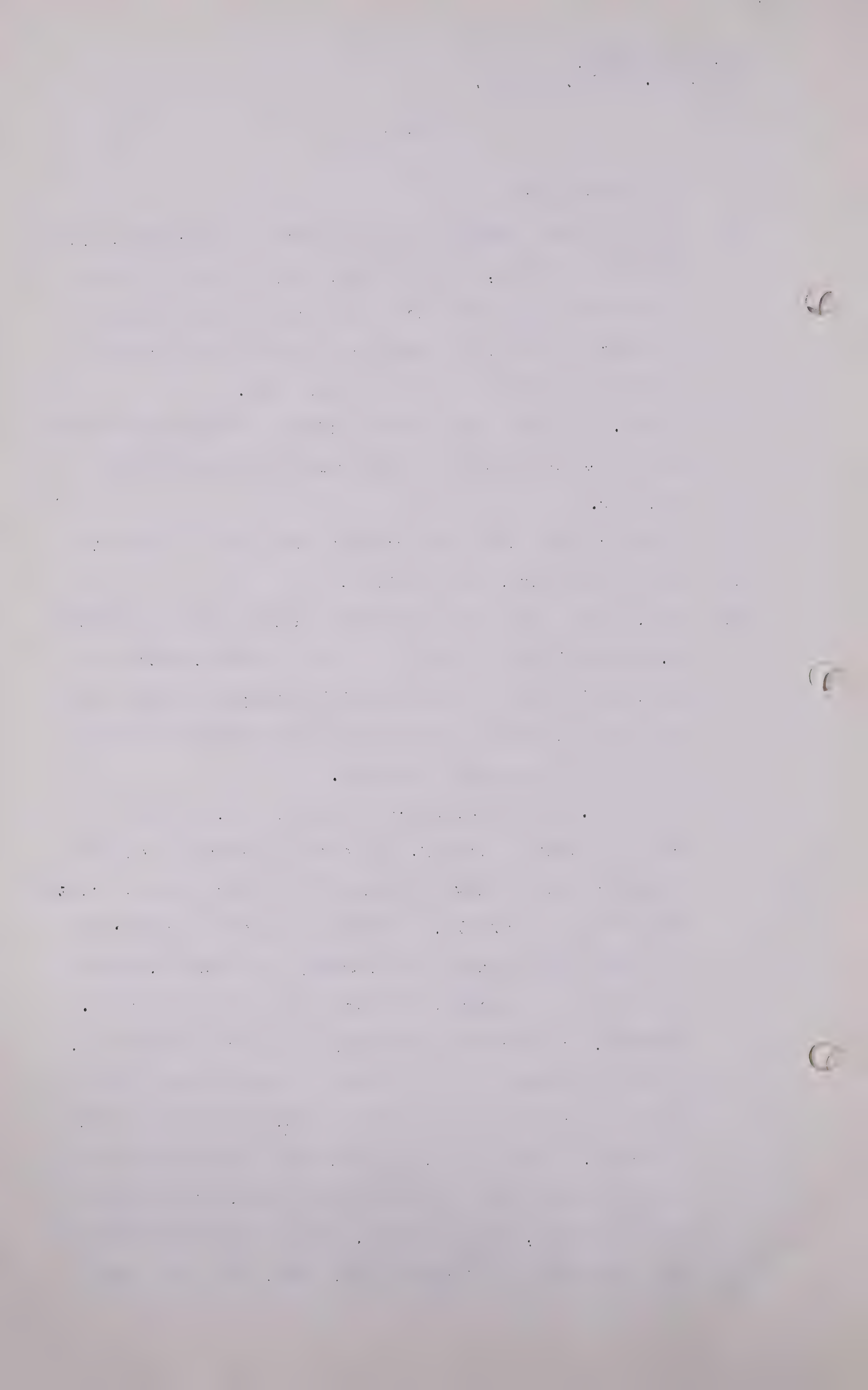
A No, sir.

Q They are just areas you did not have time to get to?

A In a large part, that is true.

Q Now, would you like to take the earlier parts of volume 3, and just tell us how it is put together, having in mind that counsel and staff will perhaps be using this document and might like to know just how best to take full advantage of its contents.

A Yes, sir. Volume 3, which is Exhibit 10, is not a complete unit by itself. In order to find all of the reserves that we have estimated it is necessary to consult Exhibits 4, 4-A and 10. However, we have in all cases by census divisions made a summary in volume 3, which is complete in summary form for each field estimated. However, the back-up sheets may be found in volumes 1, 2 and 3 and there is a notation on each summary sheet where the back-up data may be found, giving the volume and page. I do not believe that the totals that we now have estimated have ever been discussed, the totals as of August 1st, 1951, that is, data which is available or was available as of August 1st, 1951, that they have



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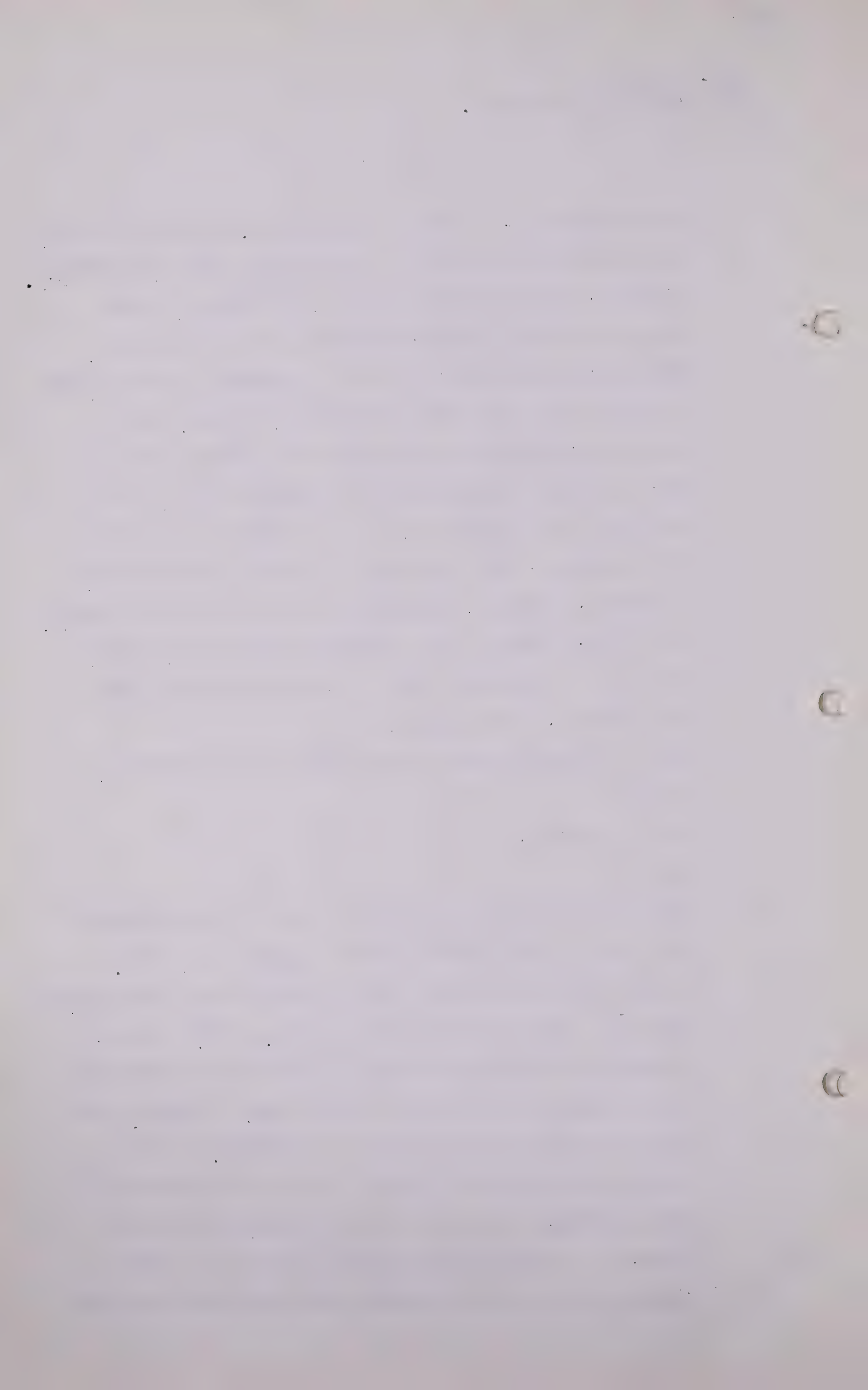
been discussed, although I believe Mr. Steer did mention some of those totals in his questioning of Mr. Dougherty. However, I should like to refer, if I might, to the tabulation which appears immediately behind the tab, "Provincial Reserves", which is a summary of natural gas reserves of the Province of Alberta, Canada. That particular tabulation summarizes the reserves which we have estimated as of January 1st, 1951, but with data available as of August 1, 1951, by census divisions and by categories. The recoverable reserves are classified as proved, probable, total proved and probable, possible, and total. Then we have computable reserves available for sale by deducting losses through shrinkage, field use, flaring, and so forth.

Q That is in keeping with the Board's letter written in August?

A That is correct, sir.

Q Yes?

A And we show then by census divisions the gas available for sale by census divisions as of August 1st, 1951. In this table we likewise make comparisons of our estimates with data available as of August 15th, 1951, and list by census divisions the changes that have been made by census division as in total on this page. Finally, we include reserves deferred by oil production. These reserves are primarily gas cap in the D-3 horizon of Leduc-Woodbend. The total of that item is some 460 billion. I might point out that that has not been included in the total which we have referred to in past



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evidence, or past testimony, the total of 8 trillion 415 billion 442 million.

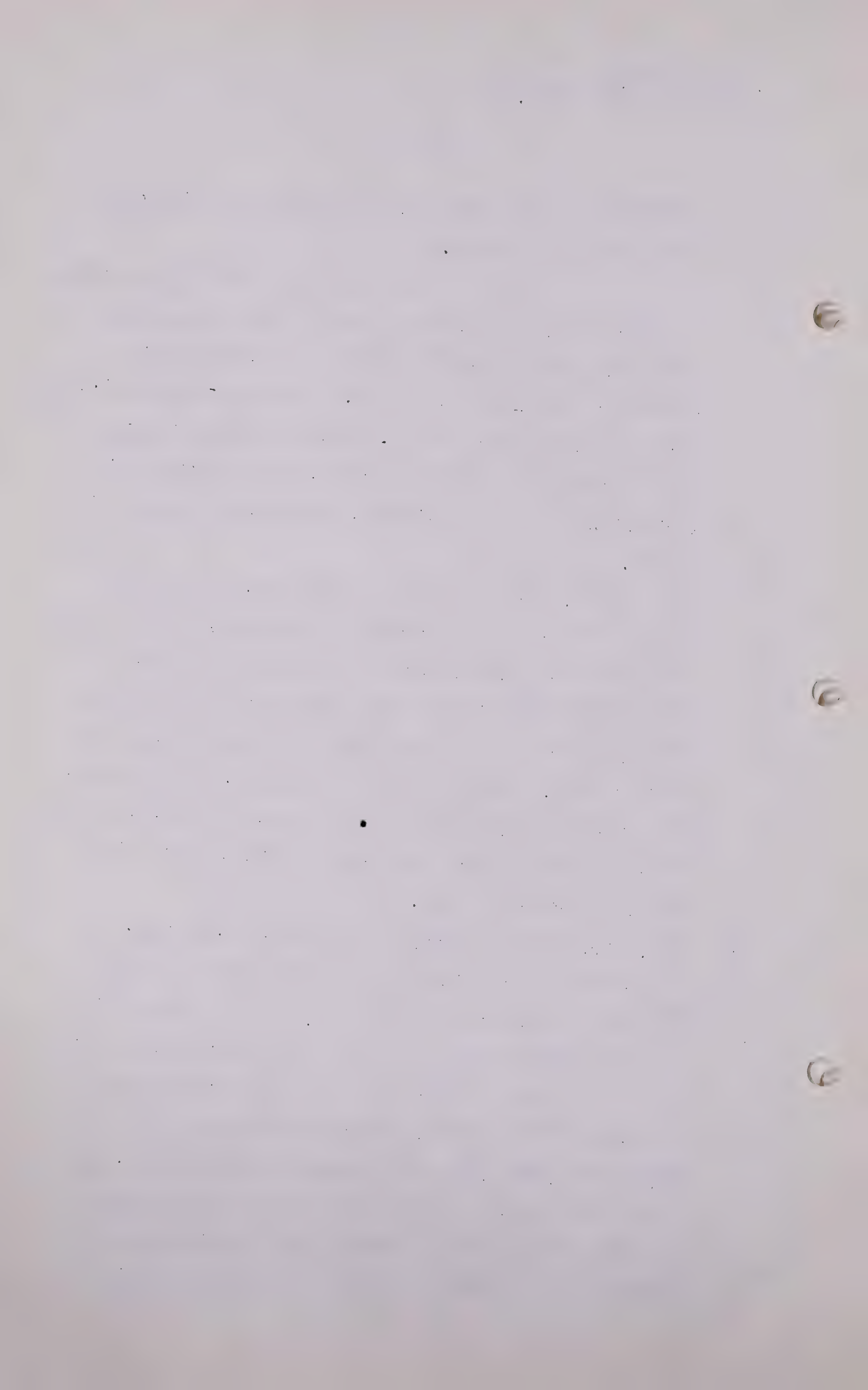
At the base of the page we made a comparison by the various items of the changes which have been made with data available as of August 1st as compared to the April 15th data. In total on an available for sale basis our current reserve estimate is now greater than the estimate placed on the record as of April 15th by some 529 billion, 423 million cubic feet of gas.

Q Mr. Trostel, this might be a handy time, so that the figures will be in the record at one place, to tell the Board whether since August 1st there have been any happenings either in new discoveries or in old fields that might have some effect on your thinking, and also their totals. There is some information, I understand, and I can tell you about two of them, Tangent, and I think there is some information about Cessford, which might be put in at this stage.

A Yes, sir, I will be happy to do that, Mr. Porter.

Q You can do it in detail subsequently, but I thought perhaps if you could give some idea of the total effect then the figures would be all in one place in the record.

A Fine. The data available to us for the computation of reserves of the recently discovered fields as of August 1st, 1951, are quite meagre in many cases, and it is only since we have been in Calgary for the past two weeks that we have obtained later information on several of the fields. I have in mind the Cessford



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field. I believe Mr. Dougherty reported on the results of the completion of wells 7 and 9 a few days ago. However, no additional reserves had been computed then for those wells at that time. In the interim, we have had a chance to review the data and feel that wells 7 and 9 have added a reserve of 155 billion 263 million cubic feet of gas.

In the case of North Tangent -

THE CHAIRMAN:

Mr. Porter, I wonder if Mr. Trostel could give us the amended figures by referring to the estimates in volume 10, Exhibit 10, volume 3, and we might correct these as we go along.

MR. PORTER:

Yes.

Q Will you do that, Mr. Trostel?

A Yes, sir. In the case of Cessford, reference may be made to page 1 of census division 5, Exhibit 10. It will be noted that our estimated reserves available for sale as of August 1st, 1951, total 423 billion 135 million cubic feet of gas. As mentioned shortly before, firm analysis of data obtained from the drilling of wells 7 and 9, Cessford 7 and 9, of Canadian Delhi, we estimate that an additional reserve of 155 billion 263 million cubic feet of gas available for sale has been proved. That difference arises, or raises the new total, I think, for the Cessford field from 423 billion 135 million cubic feet to 578 billion 398 million cubic feet of gas.

In regard to the North Tangent field as of August 1st, the North Tangent field is

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located in census division 16, and that is the same field that has been referred to by others as the Tangent field. At the time our estimate was prepared, we had data only on two wells, only one of which was a producer. In the last two weeks we have obtained data on two additional wells and have made a tentative estimate of the reserves taking into consideration these two new wells which are wells Nos. 3 and 4.

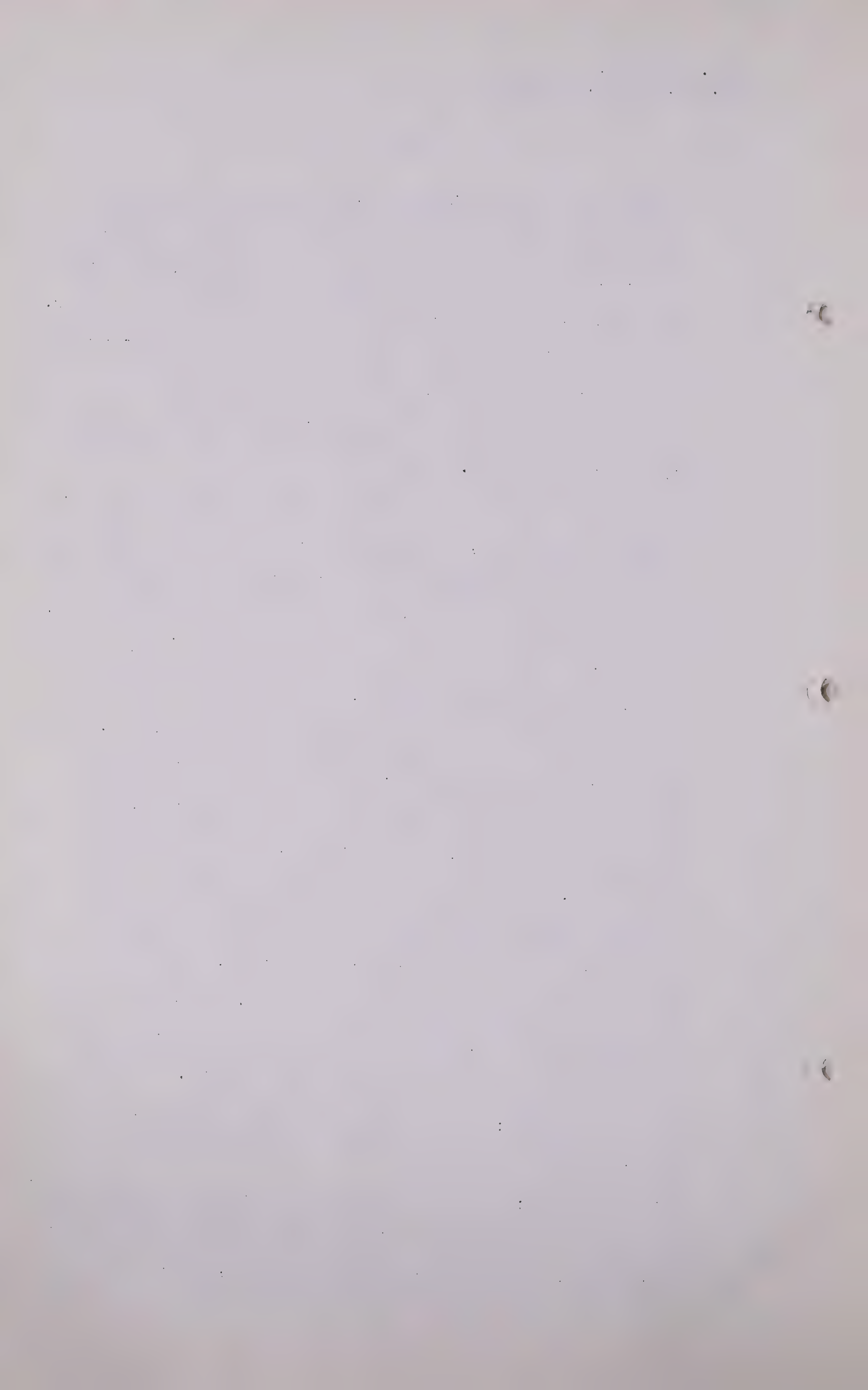
Now, if I may refer to page 1, census division 16, of Exhibit 10, it will be noted that we estimate available for sale reserves as of August 1st data totalling 28 billion 423 million cubic feet of gas. However, we do not feel that we have the right answer at all yet for North Tangent, as we still do not have information on the latest well which was completed, I believe, over the weekend, and information from that well has not been included in our new estimates, and which we would like, therefore, to qualify that as tentative. However, we have increased the North Tangent reserves available for sale by the amount of 30 billion 677 million cubic feet which, when added to the 28 billion 423 million cubic feet, gives us a new revised total of 59 billion 100 million cubic feet of gas as of data available to September 15th.

Q MR. C.E. SMITH: That is wells 3 and 4?

A That is correct.

Q THE CHAIRMAN: Mr. Trostel, have you got that broken down between the three sands that are involved?

A I'll have to consult my notes for that, sir.



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Q MR. PORTER: I understand that the information on this other step-out well has just come over the weekend and it is still being studied, and perhaps Mr. Trostel will be with us for a few days, and it might be wise for him to try to bring the whole picture up to date, including the one which is now under study.

THE CHAIRMAN: We would appreciate that, if you can give us the revised figures before you are through.

MR. PORTER: Yes, Mr. Chairman. What I had in mind in asking Mr. Trostel about this figure, and asking him to put this figure in the record alongside these totals was to get some round figure, a horseback figure, on the extent to which as of this date you would add to this figure of 8 trillion 415 billion by reason of information that has come to him since these figures were compiled.

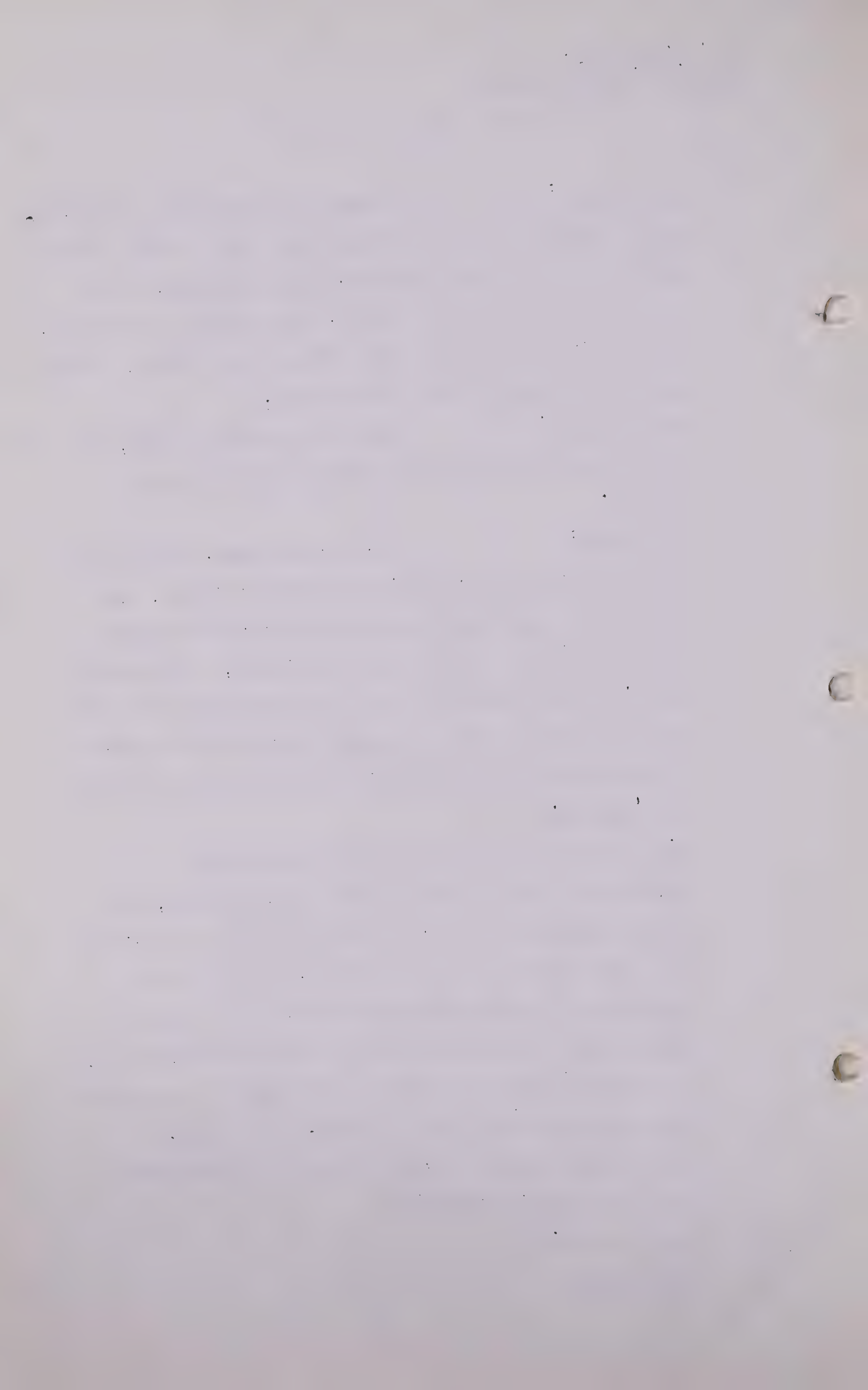
Q Now, you have given us the 30 billion figure?

A The other discovery I had in mind is Hamlin Creek, and it looks reasonable to us, although we have not decided as to what category to put it in yet, but it looks reasonable to us that some 100 billion cubic feet of gas shortly will be developed in the Hamlin Creek field, which would bring the total to some figure on the order of 280 billion cubic feet, I believe, of a total.

Q That you were going to add, or that you would add to your 8 trillion 415 billion?

A That is correct.

Q Tentatively?



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A That is correct. Mr. Chairman, does that satisfy your request for the moment?

THE CHAIRMAN: Yes, we would like to have any further details you can give us to supplement the previous information.

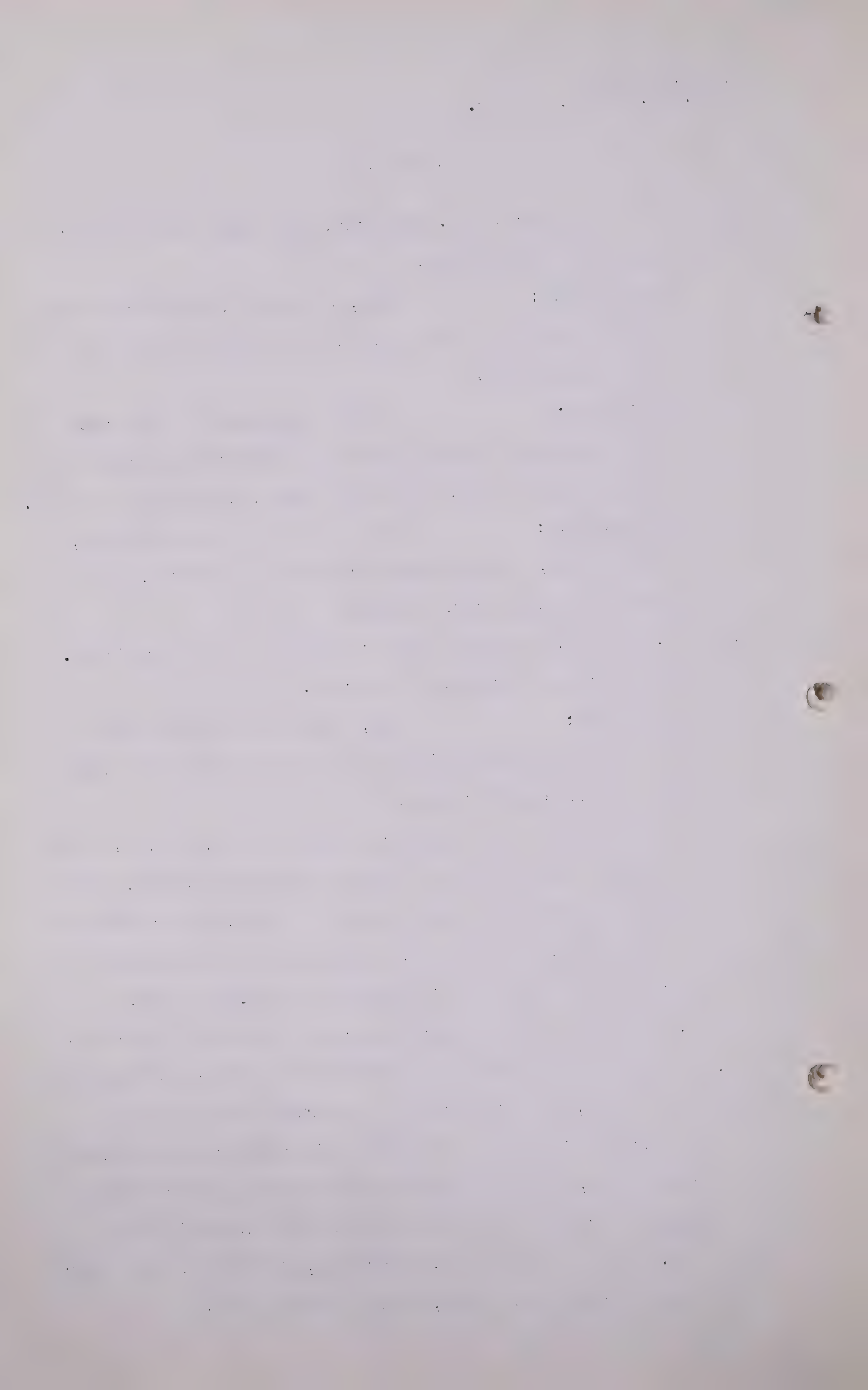
MR. PORTER: I will undertake to give you that altogether when we have the information on this last well and then it will be in one piece, as far as I can go.

THE CHAIRMAN: The last field you mentioned, Hamlin Creek, you will show how that is derived, or is there some basic data in here?

A No, there is no basic data in evidence on Hamlin Creek. That will be a brand new district.

Q MR. PORTER: Now, have you anything more to say about the information on the sheet behind the index page, Provincial Reserves?

A I was going to make another comment or two, sir. It will be noted that our table proved reserves, probable, total proved and probable is shown as a total at the bottom of the page for, I would say, possible and total categories for the two dates as of August 1st and April 15th. Although we have a reserve which we estimate as recoverable at the surface of 11 trillion 62 billion 833 million cubic feet, we only show as available for sale the comparable figure of 8 trillion 415 billion 442 million cubic feet, the difference representing the shrinkage which averages out for the Province at approximately 24%. That, I might say, shrinkage, field use, and other field facilities, waste, flare and so forth.



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Q MR. PORTER: Isn't there a plus to that figure of 8 million 415 thousand under the item probable deferred by oil production?

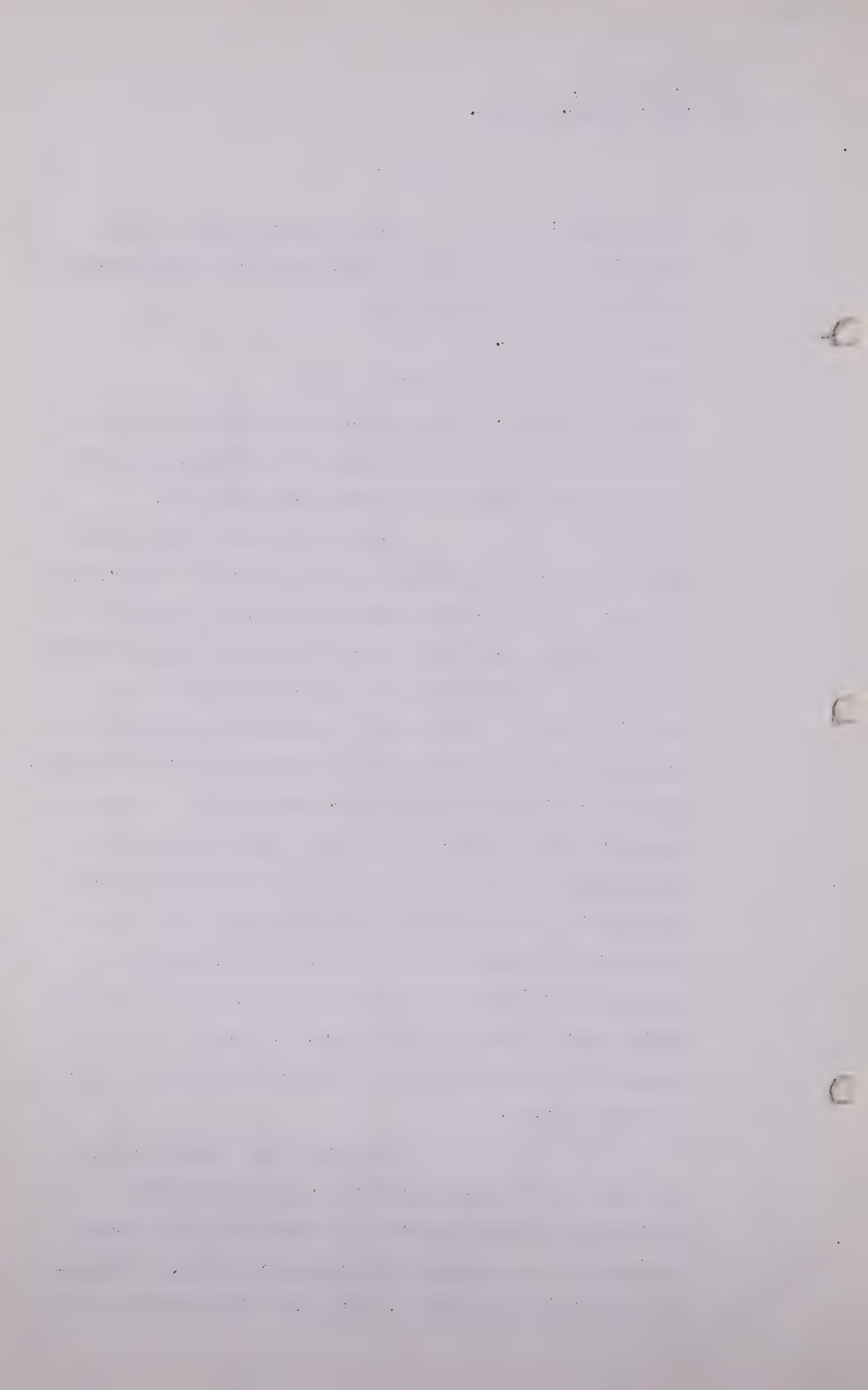
A That is correct.

Q Amounting the 1st of April to 429?

A That is correct. I was making the comparison of the shrinkage and comparable items of recoverable reserves at the surface and finally available for sale.

A new division or section in Exhibit 10 appears behind the label "General Data", and I should like to rapidly review the pages contained in that section. All these general data were prepared with the concept in mind that they would be helpful and understanding in evaluating our reserve estimations. At page 1 of this section is a total "Generalized Columnar Sections, Province of Alberta". That is page 1 under the general data section. There is a certain amount of difference in opinion and differences in nomenclature between the various people in reference to one sand or another in various parts of the Province, and those columnar sections were prepared to show how we used the terms which appear in our report. I believe they will clarify any difficulties in interpretation which might otherwise arise.

I should like then to refer to page 2 of the same section. Page 2 provides a systematic classification of our natural gas reserves estimated in accordance with geologic charts. Throughout the entire exhibits 4, 4-A and 10 the reserves have



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been set aside geographically. However, this is an attempt to indicate the amount of gas reserves for the Province as a whole which occur in the various horizons by geologic units. Page 3 is a summary classification of fields and prospects by types of gas. It shows a number of prospects which we investigated. It shows the various status and their classification. I should like to make a correction, if I might, to the totals which appear on this page. On the line entitled "Grand Total under original estimate 8-1-51", that number which shows in the exhibit as 34 should be 33. Following that line across the total should be 103 instead of 104. Our new discoveries since 4-15-51 should be 25 instead of 26 and finally, on the bottom line of the page, the total number estimated again should be 103 instead of 104. We at one time had estimated in on 104, finally decided one of those we estimated had insufficient data and we withdrew the estimate. However, we failed to catch that on this summary sheet.

Q Does this summary mean then that there are some fields capable of producing gas in the Province on which you have made no estimates?

A There are many fields and prospects on which we have not made estimates. I should now like to refer to the table which starts on page 4, which is a classification of all fields and prospects by types of gas.

Q That is page 4 under the title "General Data"?

A I am sorry, that is page 4, under the tab "General Data". This tabulation lists various fields under, first, whether

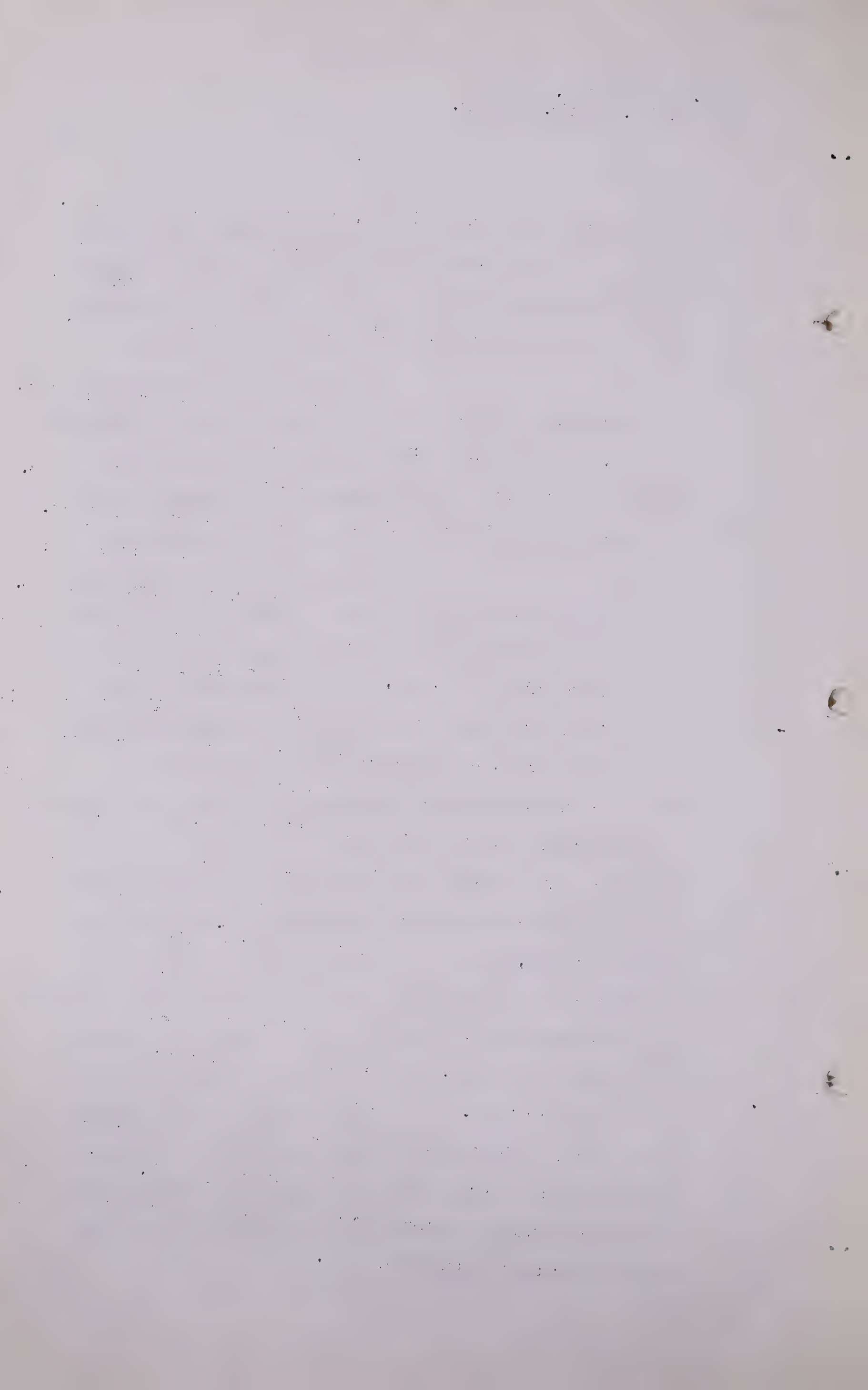
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the gas is non-associated, associated and dissolved. No, I am sorry, just by non-associated and associated and sub-classified is a list of fields as to whether they are producing, shut in, potential or prospect.

I should now like to refer to paragraph 8 following the tab "General Data" on Exhibit 10. This tabulation lists the number of fields and prospects arranged in approximate stratigraphic order. I believe this tabulation is quite self-explanatory.

Perhaps the most interesting of the general exhibits, of the general data exhibits, is the tabulation which starts on page 9 behind "General Data" tab of page 10, which is an alphabetical list of fields and prospects in the Province of Alberta classified according to their respective reservoirs and arranged in approximate stratigraphic order. By running down this particular tabulation one can see the tests and the actual producing fields which have been found in our opinion in Alberta according to increasing age. Finally, in page 24 of the General Data section of Exhibit 10 is a list of the number of fields or prospects completed annually in the Province of Alberta between 1883 and 1951. I believe these data are particularly interesting. If you will look at the last few years from 1946 through 1951 and note the number of fields and prospects which have been completed, noting particularly the sharp increase in the result of drilling during the past 5 years.



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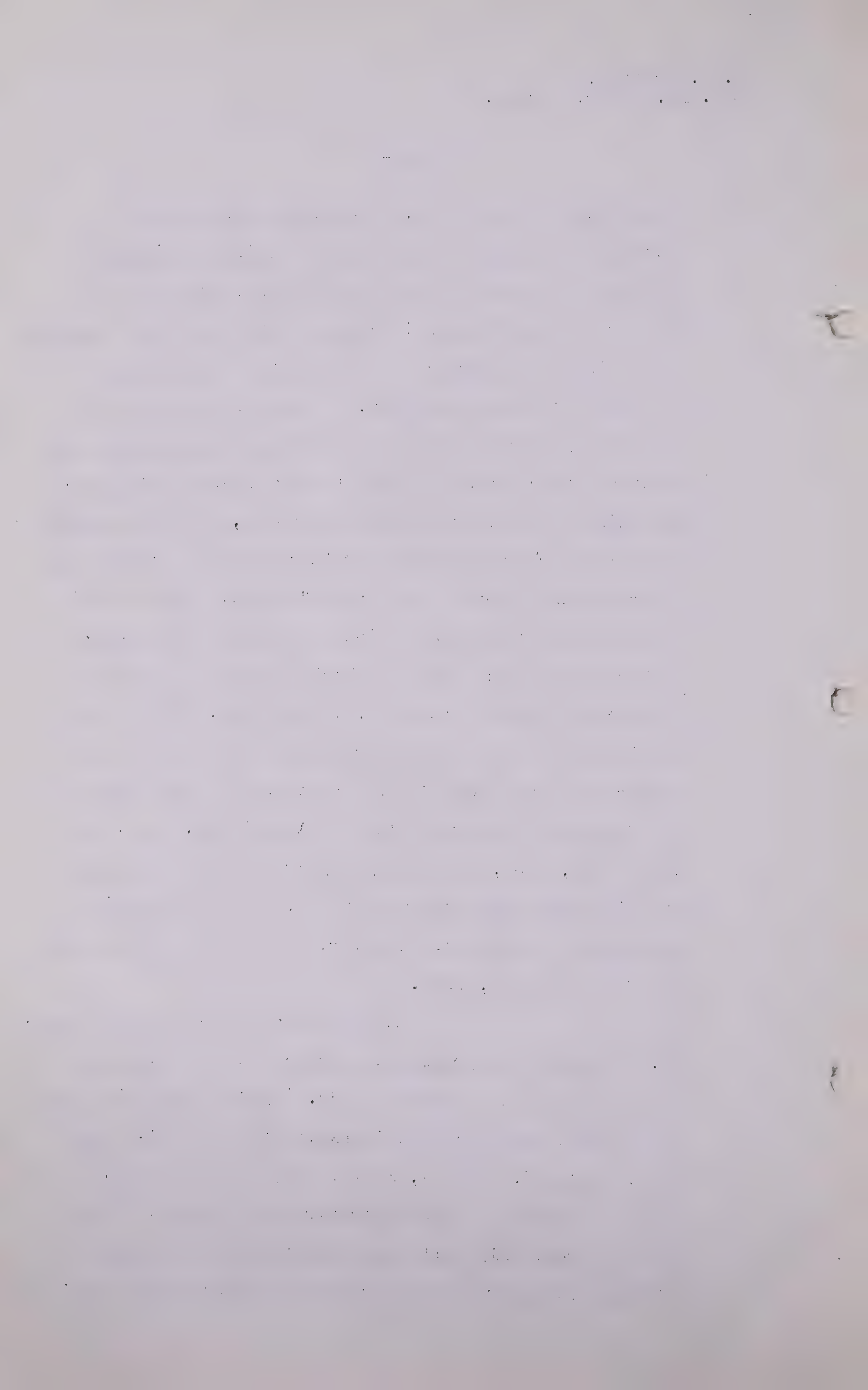
I should now like to discuss a typical summary sheet. For that purpose I would like to take summary sheets for census division 5, starting on page 1 of census division 5, Exhibit 10. It will be noted from this table that this form is quite similar to the form which appears throughout volumes 1 and 2, that is, Exhibits 4 and 4-A. However, in order to permit a comparison of the two estimates, we have introduced three additional columns, two under available for sale and one on classification of estimates. For example, if we follow through on line 2, the Cessford field, the Cessford-Delhi area, the Viking sand reservoir discovered in 1950, the depth of which is shown 2600 feet average, top of gas non-associated, particular field status is potential, although we show no proved reserves we feel it is very probable and show probable reserves as well as possible in total. And then getting over to the tabulation under "Available for Sale" as of August 1st, 1951, we show the total 18 billion 383 million cubic feet. In order to make an immediate comparison with the figures previously cited, we show in the next column headed "Changes since April 15, 1951", that is column 14, that we have increased our reserve estimate for that particular horizon by 8 billion 414 million cubic feet. Then so far as classification of estimates concern column 15, we note that there has been a revision in that pool and we refer to volume 1, census division 5, pages 1 and 4, on which the data concerning that particular reservoir appear in Exhibit 4. We have been

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consistent in doing that. Whenever we have made a revision or change or addition as original estimate we have attempted to show the addition which has been made or the subtraction in case we have reduced a reserve and giving the reference to the volume in which the original information appears. I mention that in the hope it may clarify a bit the difficulty experienced in relating our current estimate to our previous estimate. And while I am talking about that phase, I might attempt possibly to clarify a misunderstanding that occurred the other day in regard to our "as of" dates. The "as of" the reserves of all our exhibits is shown first 1951. That relates to the date at which production has been subtracted from the reserves, if you like, and by being consistent on that particular date we then are able to compare the same type figures between our two estimates. The figures or the dates "as of" August 1st, 1951, and April 15th, 1951, where they appear refer to the date at which data were available to us, the time at which we made the estimates. However, all estimates were made as of January 1st, 1951.

As has been previously mentioned, Mr. Dougherty has presented evidence on the revisions which we have made of old fields. By "old fields" I mean those which were included in Exhibits 4 and 4-A. However, volume 3, that is, Exhibit 10, contains data, reserve estimates of 45 reservoirs in 36 fields. I believe I previously mentioned that the great majority of those 45 reservoirs are reservoirs discovered prior



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to January 1st, 1951, but they were not estimated due to lack of time and also falsity of data in our original estimates. As a matter of fact, a great number of them we would probably preferred not to have estimated because the data were not too complete. However, it was our requirement that we estimate every field and pool within the Province and we have done our best in that regard. As a matter of fact, I believe it will answer a question which was previously asked Mr. Dougherty about it. There are only three new fields which we have estimated as compared with 36 fields in which new reserve data are introduced in volume 3.

Now, volume 3, in addition to reserve data, contains many deliverability schedules. These schedules are essentially the same as those presented, based on the same methods as those presented in volumes 1 and 2, Exhibits 4 and 4-A. However, I should like to go over in detail one of these deliverability schedules to discuss the various factors that went into them and explain the method of approach. For that I would like to refer to page 3 of census division 1, Exhibit 10. This particular exhibit is the Bow Island, Chin Coulee, Dunmore and Pakowki Lake fields composite projected performance - all reservoirs, and I use this particular one as an example because I believe it will be illustrative of the type of information which we put together in order to arrive at a composite performance chart and make composite calculations for a series of reservoirs.

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THE CHAIRMAN: Possibly, Mr. Trostel, we
might adjourn now and carry on. It might take some
time to give your explanation.

(The Hearing then took a short adjournment.)

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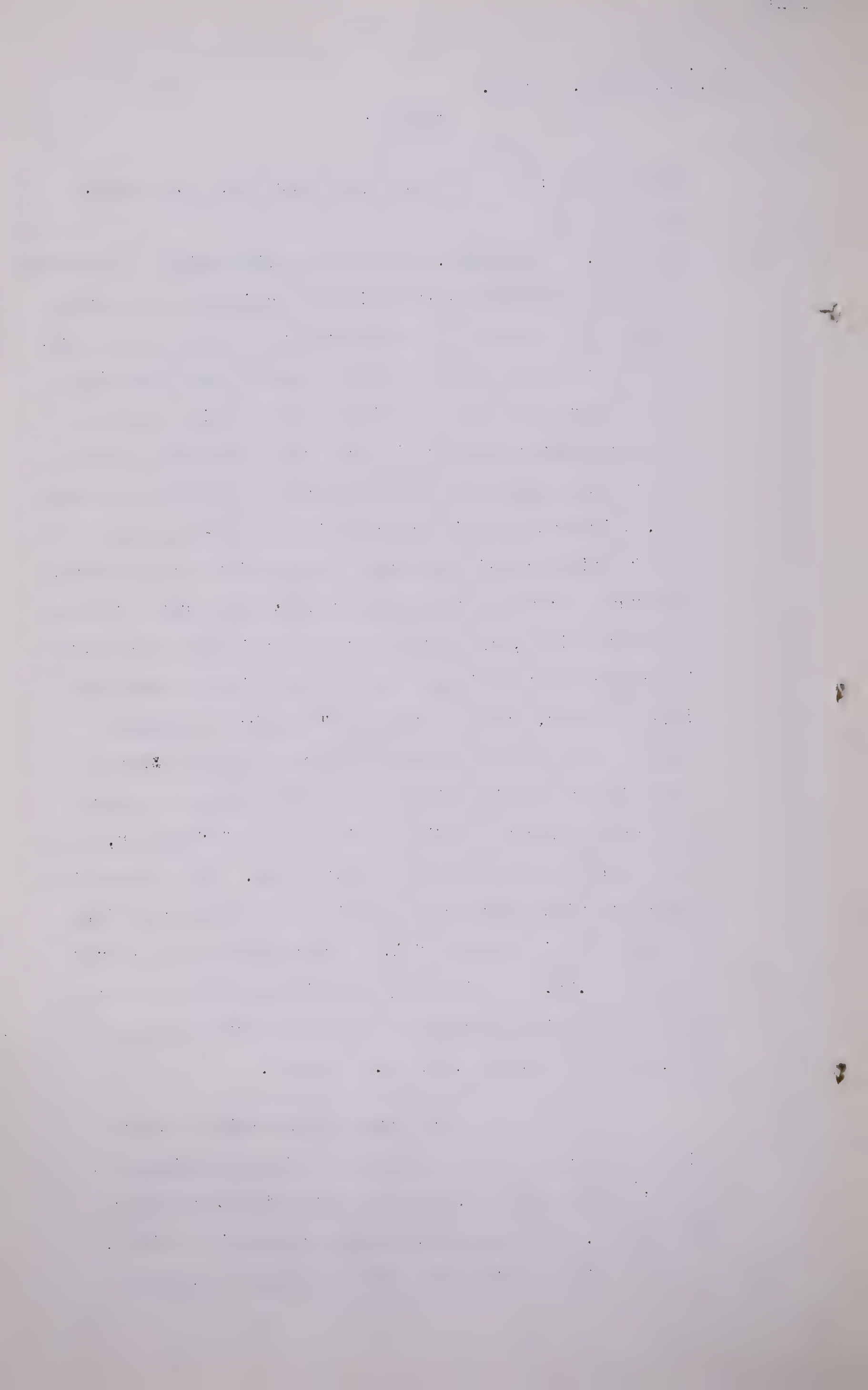
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THE CHAIRMAN: Would you carry on, Mr. Trostel, please?

A Yes, sir. Generally, all of our deliverability estimates and the schedules resulting in our projected performance figures are based on obtaining the pressures, I am sorry, are based on obtaining the performance characteristics of an average well in the field, and plotting those performance characteristics in accordance with the system developed by the United States Bureau of Mines some years ago, which consists in the plotting on log-log paper the function shut-in pressure squared minus the producing pressure squared as the ordinant versus the rate of flow as the abscissa, and plotting such data it has been found imperative that a linear relationship will be found on log-log paper, and the exponent "n" which is commonly brought into these calculations represents the slope of that linear relationship between differences in squared pressures and rate of flow, which is the "n" factor, and that represents the slope of that curve. The factor "n" generally will range from something on the order of 7/10 to something in excess of 1. Probably the best average is around .85. I might say that in cases where we do not have sufficient data to provide an actual measured "n", we have assumed .85, a .85 factor.

The particular exhibit which I wish to discuss now is on page 3 of Census Division 1, that is of Exhibit 10, and is a composite performance projection. I should like to refer you, if I might, to the various fields and pools which were weighted



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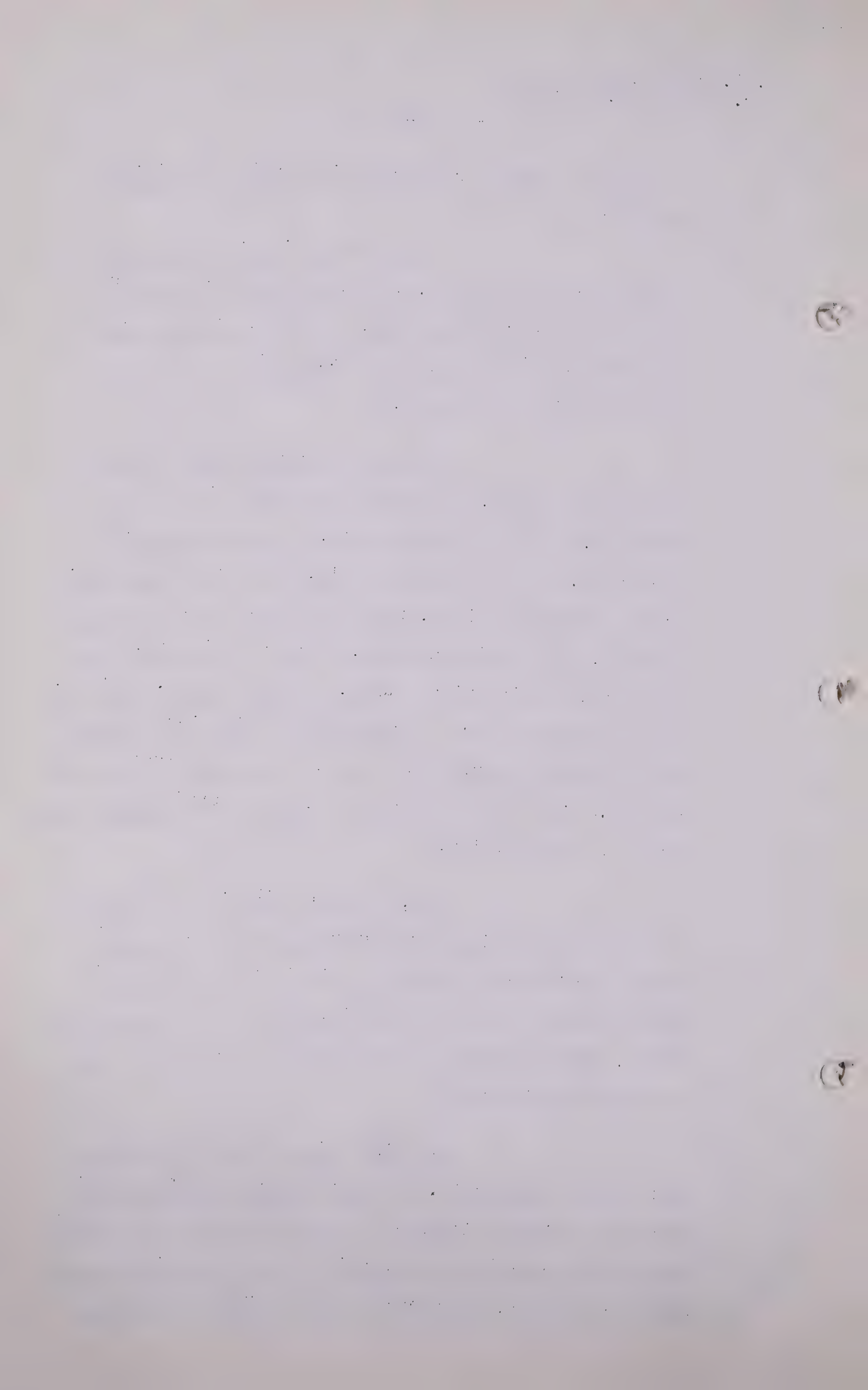
together in order to arrive at this particular projection.

I would first like to list the fields and pools involved. We have four reservoirs or pools in the Black Butte Field, the Bow Island sand, the Sunburst-Ribbon sand, the Lower Ellis, and the Rundle, which is a limestone.

In the Bow Island Field we have the Bow Island sand. In the Chin Coulee Field the Taber sand. In the Dunmore Field, the Bow Island and Ellis sands. In the Foremost Field, the Bow Island sand. In the Manyberries Field, the Bow Island sand. In Pend d'Oreille, the Bow Island sand. In the Pinhorn, the Bow Island, and in Smith Coulee, the Bow Island. That is, this performance chart represents the weighting together of 13 separate reservoirs, most of them approximately the same age, with the Bow Island being the predominant sand in all of those fields.

Now, I should like to go over the exact method of weighting performance and development and the performance characteristic in this particular field, because the method is similar to that used in all others, with a couple of minor exceptions, which I wish or shall explain later.

We first line up the reserves for each pool or reservoir. We then tabulate alongside of that the estimated initial reservoir pressure. We then develop the correlation depending on the gas gravity and depth and factor, to correct from subsurface to surface



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pressure. We then calculate for each reservoir the shut-in initial surface pressure, or the shut-in pressure at the time our calculations start. We then weight that pressure by multiplying it by the reserve in the particular horizon to carry out this multiplication for each of the 13 horizons. We then end up with a product of pressure times reserves. We then are able to arrive at an average pressure for our composite, which consists of dividing the product of pressure times reserves by the summation of the reserves to give an average pressure for the 13 horizons weighted in accordance with the reserves. Then from data available we estimate the average wellhead open flow, that is the average wellhead open flow, for an average well in each of the horizons.

I might just mention, though, in passing, that Black Butte in the Bow Island averaged 5 million a day, Sunburst 6 million, Lower Ellis 7 million, Rundle 7. The Bow Island, the Bow Island sand, 4 million, which may be low. We would like to have a little more information on that reservoir. Chin Coulee, the Taber sand, 2 million. Dunmore, 3 million a well, in each of the Bow Island and Ellis sand reservoirs. 8 million for each well in Foremost. 24 million for the average well in Manyberries. 14-8/10 for the average well in Pend d'Oreille. 3 million for the average well in Pinhorn. 6 million for the average well in Smith Coulee.

Q MR. STEER: We do not have these figures on any part of this exhibit?

A No, sir, those figures are not in there. We then review the number of wells in each particular reservoir and estimate

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under a reasonable development program what will be the total number of wells to be drilled to develop each reservoir. For example, Black Butte, we estimate as one well. Now, we estimate that a three-well total will be necessary to develop that reservoir. That is, if those are individual well completions or if they are dual completions. Either those, or however the operator intends to do it, or prefers to make the completion. We estimate the Bow Island sand in Black Butte will have 2198 acres per well, and we are only going to have 1 well draining that particular area. And the average works down to the Sunburst Ribbon, one well for 3539 acres per well, the Lower Ellis 4192 acres per well, and the Rundle 2375 acres per well. We think that we have drilled only a sufficient number of wells to provide the necessary deliverability. It is quite possible that a greater number of wells than those we have estimated will be drilled during the course of development of these reservoirs. That may well be. However, we have in all cases made an examination of the economics of the drilling program proposed in terms of reserves, and have been guided by a very rough rule of thumb that in no event should the drilling exceed a cost of 2 cents per Mcf of gas reserves in the ground. That has been the general basis for the economics of the drilling program which we have proposed, not only here, but throughout the other fields.

Q DR. GOVIER: Mr. Trostel, would you care to elaborate on your rule of thumb, how you apply that rule of thumb?

A Well, just in this manner we looked at the reserves in a horizon, and we considered the number of wells which we

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thought would be adequate to drain and provide the necessary availability for that horizon. We then said that, in our opinion, the drilling of such wells should be able to be supported on a basis of a value of 2 cents an Mcf in the ground. In other words, that should pay for the cost of drilling, and then whatever else the operator should make over and above that for the sale of the gas, will be used for operation expense and for profit.

Q Where do you get the 2-cent figure?

A It seemed a reasonable figure.

Q Was it based on any previous experience?

A Well, let me put it this way: It was not a measure of drilling costs; it was a measure of a ceiling. In our opinion it is hard to believe that gas will be sold certainly for less than 2 cents an Mcf, that probably gas will be sold at some figure in excess of that to provide a margin of profit for an operator, so that we felt that using a general rule of thumb of 2 cents an Mcf of value, surely that should be adequate protection for the drilling which will be proposed.

Q Thank you.

Q THE CHAIRMAN: Mr. Trostel, that 2 cents, would that be on the basis of the gas that would be produced over the 30-year period as shown?

A As a matter of fact, it was based on reserves, not on the availability.

Q On the reserves?

A Total reserves.

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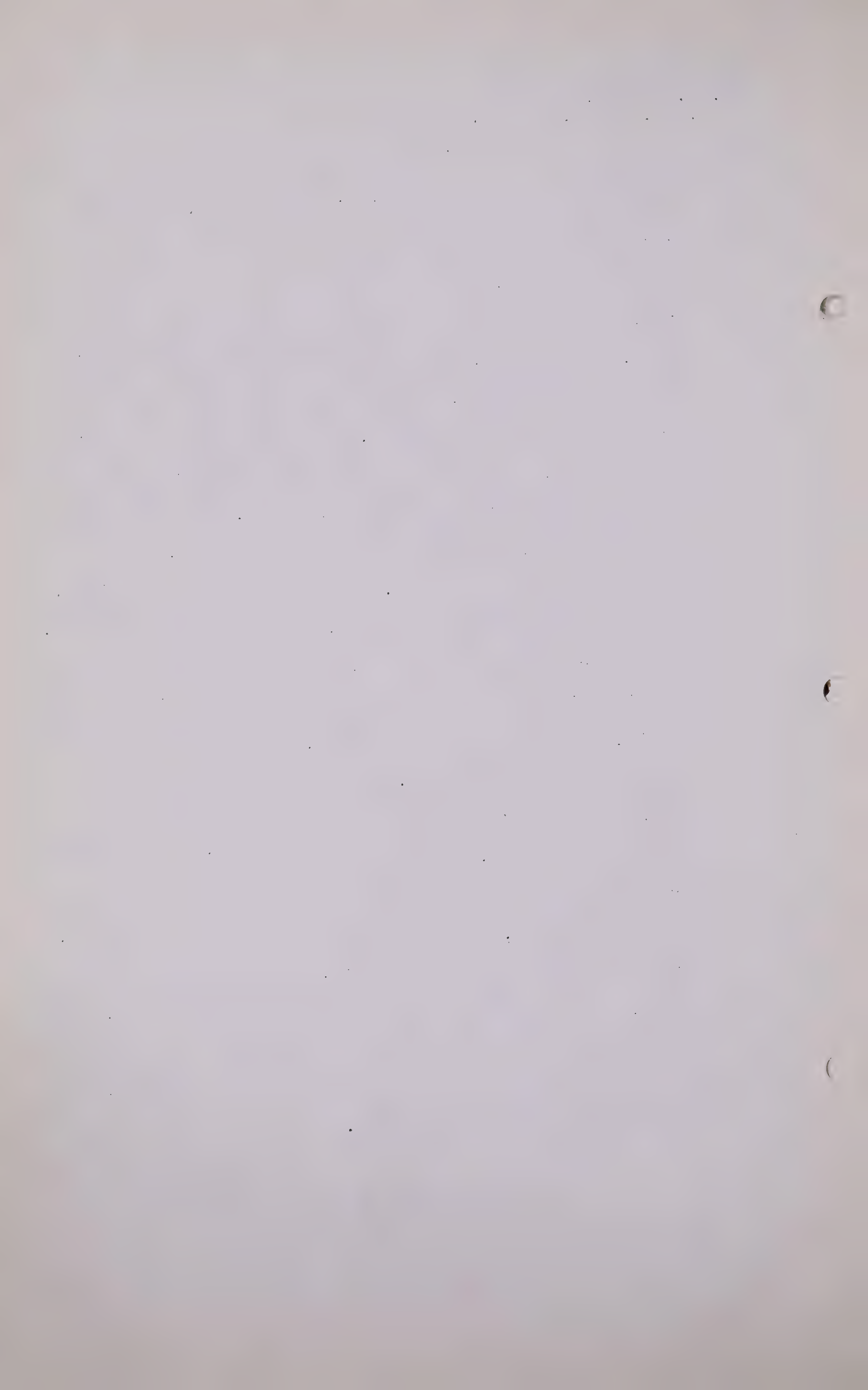
Q MR. PORTER: But it is based on ultimate recoverable reserves?

A That is correct.

Q Yes?

A Well, for example, just proceeding where I left off in the Bow Island sand, there are 12 wells there, and we propose no additional wells. The same holds true for Chin Coulee. I am sorry, I got that backwards. In the case of Black Butte we propose 4 wells, and there are 3 completions, if I may make that correction. In Bow Island there are 12 wells, and we propose no additions. In Chin Coulee there is 1 well, we propose no additions. In Dunmore there are 2 wells, we propose 3 more completions in the Bow Island and 5 more completions in the Ellis. In the case of Foremost, there are 6 completions, we propose a total of 10. In Manyberries there are 4 completions now; we feel that 7 will be adequate to develop the field. In the case of Pend d'Oreills, there are now 3 wells; we propose a total of 34. In the case of Pinhorn, there are no wells presently proposed. Smith Coulee, there are 2 wells, now we propose a total of 3. Within this group of fields and reservoirs, there are now 41 wells and we propose a development or a program to the end effect with a total of 80 well completions, we hope that will be achieved.

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We then weight the average open flow per well for our final proposed program marked for initial and then examining year by year as the development takes place to the end point and, as a matter of fact, the exact weighting of this open flow gives us 10.9 million per day per well. We have used 10 million per day per well as the average well for the entire configuration, the entire projection.

Q DR. GOVIER: Mr. Trostel, you re-weighted each year, I wonder, upon the open flow basis with an 80-well maximum?

A I am sorry, it is done on the basis of 80 wells maximum. It is evaluated each year in areas and the number of wells which are drilled.

Q Yes?

A Based on the average of 10 million per well. In other words, no attempt is made to definitely close a well in any year.

Q What well density have you used in connection with this 80 wells?

A 3065 acres per well. That is the total acreage divided by the total wells and some of that acreage is co-extensive. I believe that reviews the background underlying this particular statement. I should now like to go through some calculations very briefly. As I recall reading the transcript and what I heard of Mr. Dougherty's testimony generally in the May hearing, I do not believe it is necessary to go through it in full detail but I would like to refer you first to column 10 of this exhibit, "Average

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Shut-in Well Head Pressure at year end." Our weighted initial pressure and I might perhaps not have mentioned it, was 818 pounds per square inch absolute. That is our starting point. It is then proposed to check the data of the total daily gas production indicated in Column 8. That then corresponds to and is well expressed as the cumulative gross annual gas production in Column 6 and the system is merely one of deciding on the open flow capacity as at the beginning of the year and then the number of wells and averaging the wells to decide on the amount of gas which will be taken out during that year and computing then what the average drop in pressure will be resulting from that withdrawal, which then gives the pressure at the end of the year and that approach or that method, followed year by year, is a guide when that can no longer be continued. It cannot be continued indefinitely at a higher rate and we have computed it for each year end. That is Column 11, the estimated total open flow capacity. A more practical figure than used in this control is Column 12, "Estimated Total Delivery Capacity against 613 pounds per square inch absolute at year end." That is modified later on. I might say we would estimate what is proposed in the set-up that any well in the reservoir, or in this case a composite group of reservoirs, has only to produce a desired rate against the back pressure. As an example take 1956 as shown in Column 12. It is essential to reduce the line pressure by 100 pounds from 613 to 513. Then follow three years' production as noted by footnote c, Column 12. The field or group of fields, when unable to produce at the

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rate against a pressure of 513 pounds per square inch absolute, the line pressure is further reduced and we then step down to a final line of pressure as shown by footnote (e) on column 12 of 213 pounds per square inch absolute, at which time that back pressure was maintained and production essentially allowed to float, if I may use the term, on that line pressure from there on out. I should now like to refer to the last six columns on page 3 of this exhibit, entitled "Estimated Gross Peak Day Volumes and Per Cent of Total Well Head Open Flow Capacity". In the previous exhibits, I might say, we had produced no data concerning the peak day volumes. These particular six columns indicate the per cent of total well-head open-flow capacity which would result from the production of a proposed volume of gas under three load factors, under the lowest in Column 13 45%, an intermediate point of 65% and a final load factor of 85%. The flow capacity for an 85% load factor, the proposed rate of production in per cent of total well-head open-flow capacity is illustrated or shown in Column 18. For the entire period it represents an average of 22% of the total well-head open flow capacity. At 65% the load factor, to meet these peaks, it will be necessary in order to meet a 65% load factor for this particular group of reservoirs to produce, as shown in column 16, that is to produce the percentages shown of the total well-head open-flow capacity. They start off around 18% and run up to 41% and eventually taper off to 14% and average 28.8% of the well-head-open-flow capacity. In the case of a load factor as low as 45% we start with 25.6 of the total well-head open-flow

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capacity, which rate perhaps would build to a peak of nearly 60% of the total well-head open-flow capacity in order to provide those daily peaks. The average for that load factor would be 41.6% of the total well-head open-flow capacity. I think this might be a good time to comment, at least in my opinion, in regard to the limitation of production in terms of well-head open-flow capacity. In my opinion there is nothing sacred whatever about 25%. I think it was first introduced as a convenient figure, as far as I know, in Texas at least, from a regulatory standpoint in balancing the load or balancing the allocation, I should say. I do not know of any way of predicting the maximum rate at which a gas well can be produced without damage. As far as I am concerned the only way that can be determined is by experience. I do not know of any way to calculate it. In that regard essentially there are two considerations, I think, of primary importance. One of them is if one produces at too high a rate it will increase the potential which will tend to cone water into the well or will tend to finger water into a well. Generally speaking, the reservoirs examined in the Province, I know the non-associated gas reservoirs particularly, there is some reason to believe they do not have a water drive. In fact we have known of cases where water intrusion developed in very big reservoirs and that will be accelerated by pulling on the edge wells at too high a rate. So what percentage that might put the basic well potential, the well-head open-flow potential, I do not know. I think that can only be determined by experience. However, there are many cases of wells producing at 90% of their capacity without damage in the

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later stages of their life. The other factor is primarily important in a sand field and that is the velocity factor in entraining the sand which could damage the casing and sand up your well. The higher the velocity the more sand may move and it might develop in cases of loose sand to a critical rate, which, if proceeded with, a considerable volume of sand might move. I would not think that would be a hazard at all in tighter sand or a more permeable sand. That could only be determined by actual experience. I may add this is the approach which we have used throughout our studies in regard to answering the peak-day volume. That is, producing the reservoirs at a higher rate. We have in all cases indicated the present well open flow and the percentages which we estimate will result from peak periods if it is essential to produce at a 45% load factor, a 65% load factor or an 85% load factor. Returning now to the left-hand side of the chart. I believe I mentioned Column 6 which is the cumulative gross annual gas production. We also have the total daily average net gas deliveries in Column 7. In this particular case, the net gross ratio is 93%, equivalent to a 7% allowance for field and fuel uses, shrinkage, compression and so forth. We have in Columns 2, 3 and 4, maybe I should say starting with Column 4 we show the total net gas delivered in terms of an annual basis from this group of fields herein estimated. In this particular case, however, we understand that there was an export license granted for a period of 5 years and the volumes

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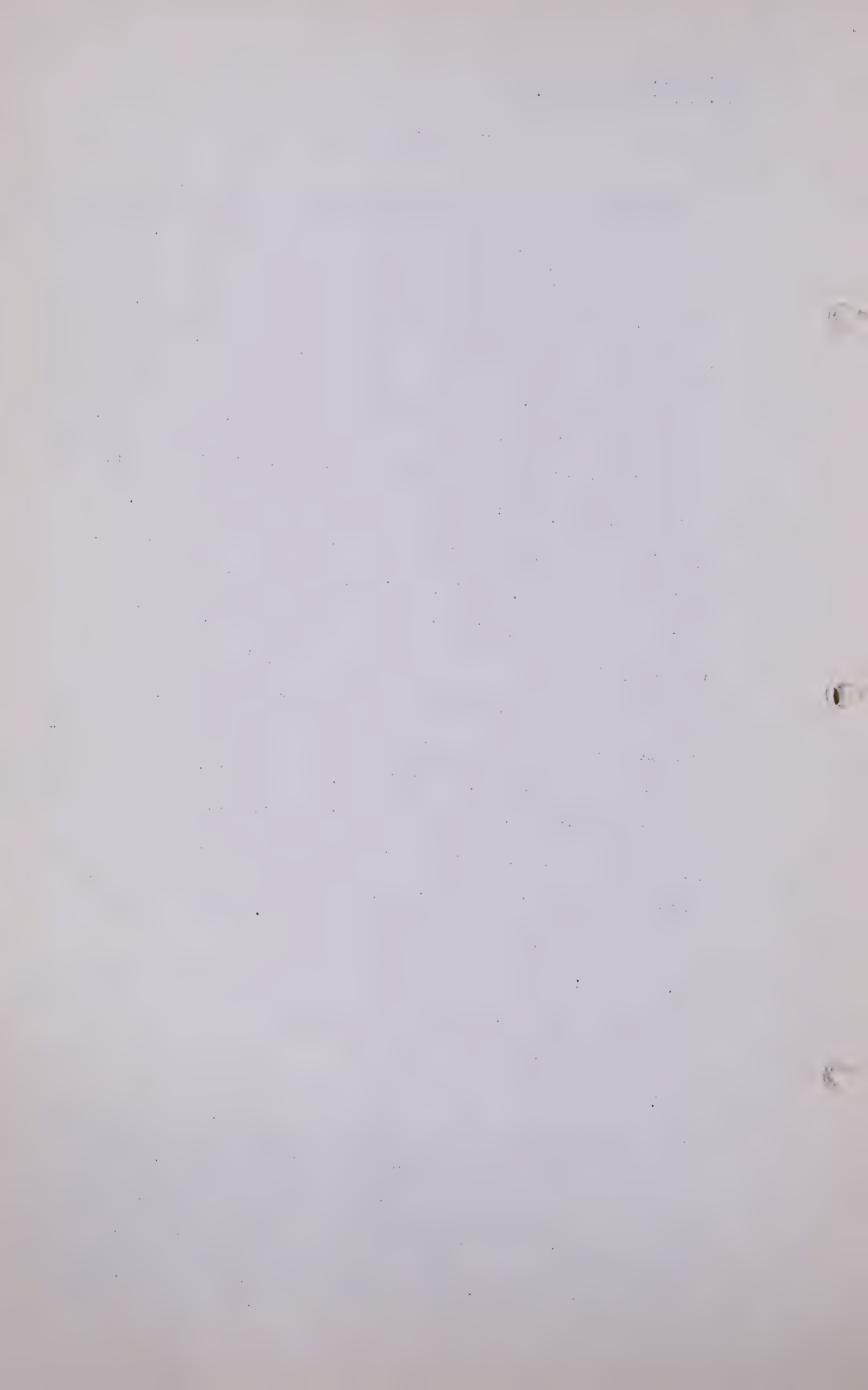
equivalent to our understanding of that export license are set up in Column 3, from which Column 2 is derived, the estimated net annual gas deliveries for provincial needs, by subtracting Column 3 from Column 4. We have shown the export of gas to Montana for only a 5-year period as that is, we understand, the length of the term of the contract. Subsequent to the 5-year period we have assigned that gas from this particular area for meeting Provincial needs. That completes, I think, the discussion on Volume 3, Exhibit 10. I would now like to refer to our Volume 4, Exhibit number 23, entitled "Composite Projection of Estimated Future Availability of Natural Gas, Province of Alberta, Canada." As mentioned - possibly I did not mention it - we submitted delivery schedules in Exhibits 4 and 4A only for those proposed gas supply fields of Trans-Canada. In Volume 3, Exhibit 10, we have introduced additional exhibits similar to the one and including the one which I just discussed, covering major fields and groups of fields which were not included in Exhibits 4 and 4A. There is the projected performance, Volume 4.

Q MR. PORTER: That includes the ones tentatively assigned to Trans-Canada plus others?

A That is correct, sir.

Q Yes?

A In Volume 4 which might well have been part of Volume 3 except for the time required to print Volume 3, we have put in or we have made projections of the remaining fields and reservoirs not included in the projections included in Volumes 1, 2 and 3, that is Exhibits 4, 4A and 10, and in



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addition by Census Divisions have made a simple summary of the total of the projections made for each Census Division and finally have summed up the entire availability picture as we have estimated it for the Province as a whole. Now I would like to read, if I may, the discussion section which appears on page 3 in the front of Volume 4.

The third page of the report section of that exhibit. It is entitled "Discussion of Projected Estimated Future Availability of Natural Gas." Now I read:

"The estimated future availability of gas for each Census Division was accomplished statistically by summing the estimated gross annual gas production, the estimated net annual gas production, and the estimated net daily gas deliveries for each reservoir, field, or group of small fields. Summation of these data from the individual Census Division Summaries resulted in an overall statistical summary of the total gas available from the presently known fields in the Province of Alberta for a thirty year period commencing with 1951.

In no sense can this overall estimate be accepted as a prediction of the actual amounts of natural gas that will become available from the Province of Alberta during the next thirty years. The Petroleum and Natural Gas Conservation Board has requested that the anticipated growth of markets in Alberta be correlated with the estimated future available supplies

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"from the presently known fields. Since the natural gas supplies in Alberta will unquestionably be increased, and substantially, by future exploration, omission of this factor results in the so-called thirty-year estimate being so conservative as to be unrealistic.

Therefore, the estimated volumes of gas as tabulated in this report should be viewed as absolute minimum volumes to be expected at any certain period. Only lack of market will depress the exploration efforts of the petroleum industry."

I wish to read that into the record just so that it may be a clear qualification of the analyzed data which I am about to discuss in further detail. I believe I have described the general approach fairly thoroughly. I would like now to discuss, if I may, the particular calculations which have not followed the general approach which I mentioned. In particular, I would like to discuss the Turner Valley field as located in Census Division 4. As a matter of fact I find that the deliverability schedule for Turner Valley is not in Volume 4 but appears in Volume 3, so I should like to refer back to Volume 3, Exhibit 10, pages 2 and 3 of Census Division 4. I would first like to refer to page 2 of Census Division 4, Exhibit 10, which is the projected performance tabulation for the Turner Valley-Rundle limestone associated gas fields. The data that appear here are quite similar, as a matter of fact



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the tabulation is identically similar to the other tabulations. However, the estimated total well-head open-flow capacity at the end of each year was estimated not from a per well deliverability chart as in the other cases but was calculated from historical information previously put into the record before hearings of the Board. I refer in particular to the evidence of Gordon Connell given before the Board, I believe, in early 1948 and I will get a check on that date. This particular exhibit was, or comprised a very extensive summary of the performance of the individual wells in the gas cap, and by "gas cap" I refer to the up-dip non-associated reservoir which, in my opinion, is essentially unrelated to the oil band. This particular set of data was placed on the record by Mr. Connell on or about January 12th, 1949. I had no reference as to the exact hearing, however, to which I can make reference.

THE CHAIRMAN: What hearing was that, Mr. Trostel?

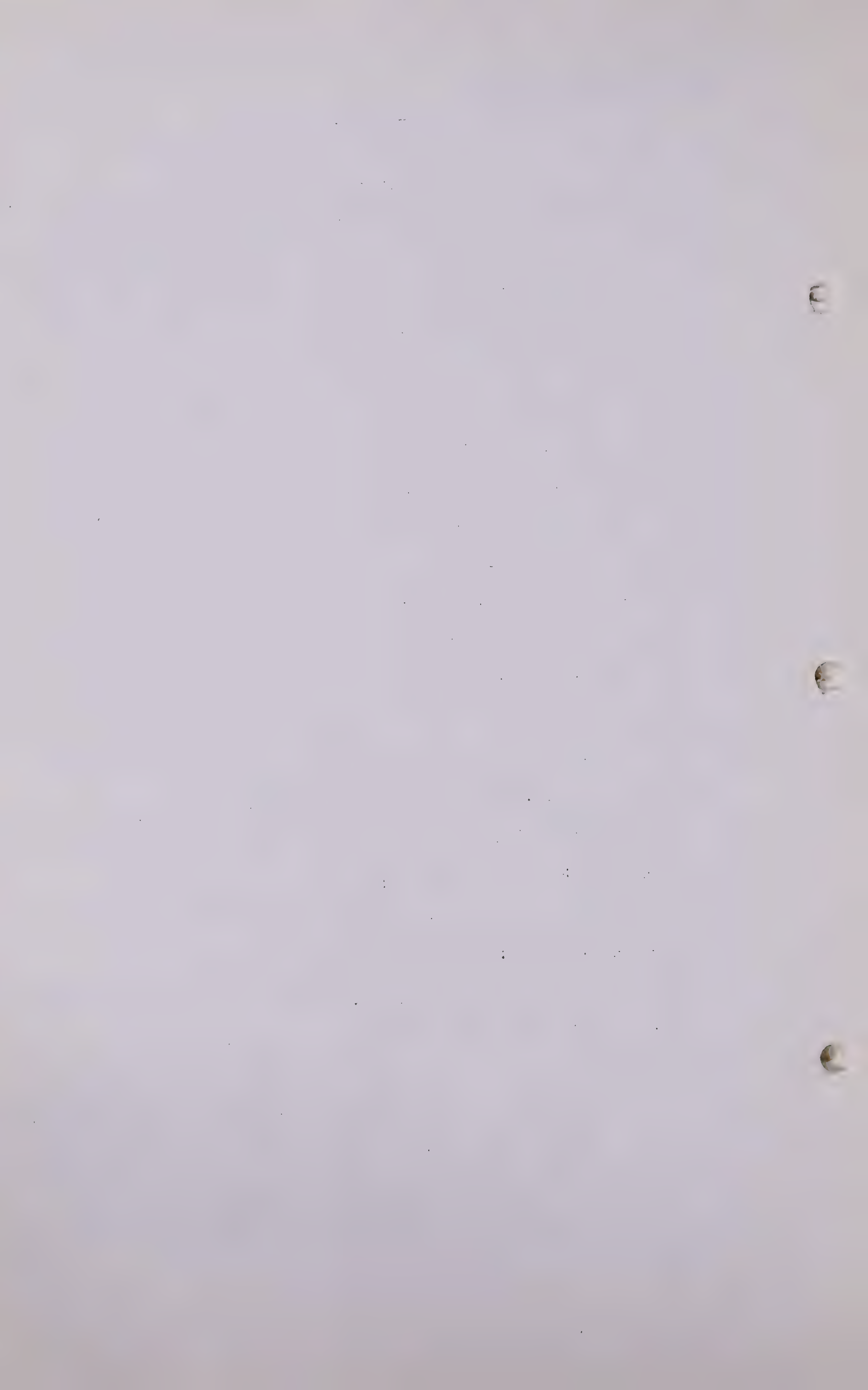
A I am sorry, sir, I do not know.

MR. STEER: I rather think it would be the Madison Gas Hearing, would it not?

MR. C. E. SMITH: He was not called at this hearing yet. He has not been called.

MR. STEER: He gave evidence at the Madison Gas Hearing very extensively on the Turner Valley reserves.

A He has made a very complete tabulation of the performance characteristics of which I was able to obtain a copy of the exhibit which was submitted to the Board on January 12, 1949.



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THE CHAIRMAN: Not to this Board. It was some other Board.

MR. MCDONALD: It was the Natural Gas Utilities Board.

A Thank you, sir.

THE CHAIRMAN: Will you give me the reference to that, please, the Exhibit number and the particular hearing at which it was presented?

A I wish I could, sir. Apparently I cannot. The only information I had is a photostatic copy which I received showing that it was presented in evidence. Apparently I am in error, I understood it was before the Conservation Board. It was presented on or about January 12th, 1949 and apparently was before the Utilities Board.

MR. PORTER: I think we can get that information from Mr. Connell. He would probably know. He might be a bit confused between the numerous Boards but I think he could make it out.

A If necessary, I can discuss the detail on which it was based. However, Mr. Connell made a very elaborate tabulation and an elaborate study and being short of time and perhaps constitutionally lazy, I preferred to check his work carefully and found it was very well done and developed from it the essential deliverability performance information which I used in this exhibit.

MR. PORTER: Have you a photostatic copy of Mr. Connell's report?

A Yes, but it is in Dallas. We could get it in the matter

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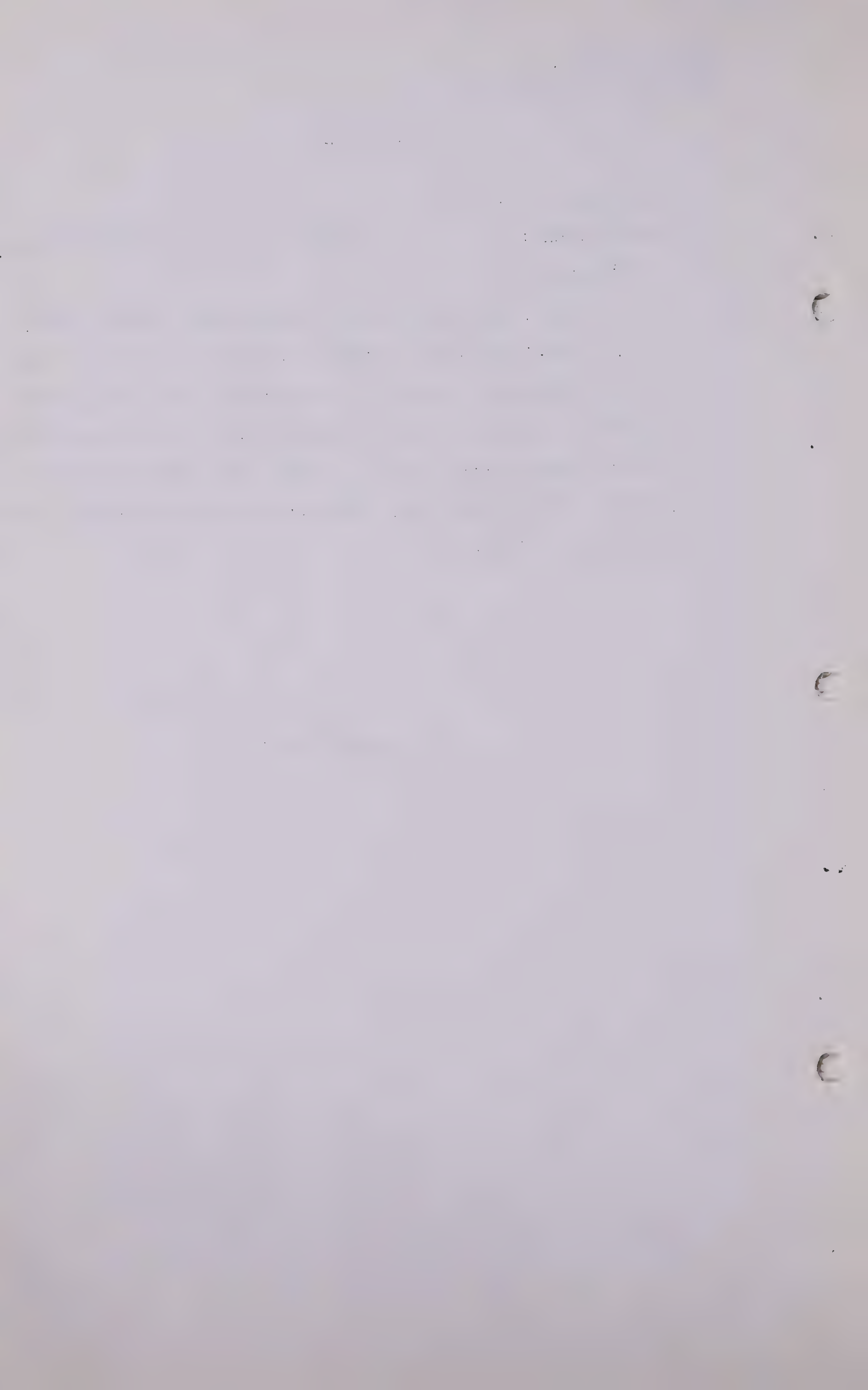
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of a day or so.

THE CHAIRMAN: I think we can get a copy of that,
Mr. Trostel.

A In any event, the procedure was essentially similar, however, the weighted data being four groups of wells in the Turner Valley gas cap and I then weighted the four groups together to give a total for the gas cap as a unit and those were the basic data on which I made this particular projection. I did check Mr. Connell's work and believe it to be highly reliable.

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A There was some question in regard to what assumption one should make as to the right to take gas from the Turner Valley field and gas cap, and I might like first before proceeding to finish the discussion of page 2. Turn to page 3. Page 3 presents a summary of projected performance on the entire Rundle Limestone of Turner Valley field broken down between dissolved gas and associated gas providing a total, columns 2, 3 and 4 on page 3. I should like to discuss first column 2 because it is somewhat basic in our consideration. Column 2 represents the results of our assumption of the future trend of production of oil and gas from the oil sand portion of the field assuming a continuance of allocation procedure that has been in effect for the past 9 years. We estimate from the trend of increasing ratio that the future gas-oil ratio would be increasing to a high of 11,000 cubic feet per barrel, I believe, and then passing the peak and then tapering off. We then estimated by years the oil production which would ensue from Turner Valley, then by years multiplied the gas-oil ratio estimate times the oil estimate - - I am sorry, by dividing the, I was right the first time - - by multiplying the gas-oil ratio times oil production we arrived at the estimated gas production each year. That was then plotted as a curve and smoothed and the results of that work here on page 3 is column 2. Then came the question of deciding how much gas should be taken out of Turner Valley in the future and this estimate is arbitrary, I think based on some reasoning which I would like to

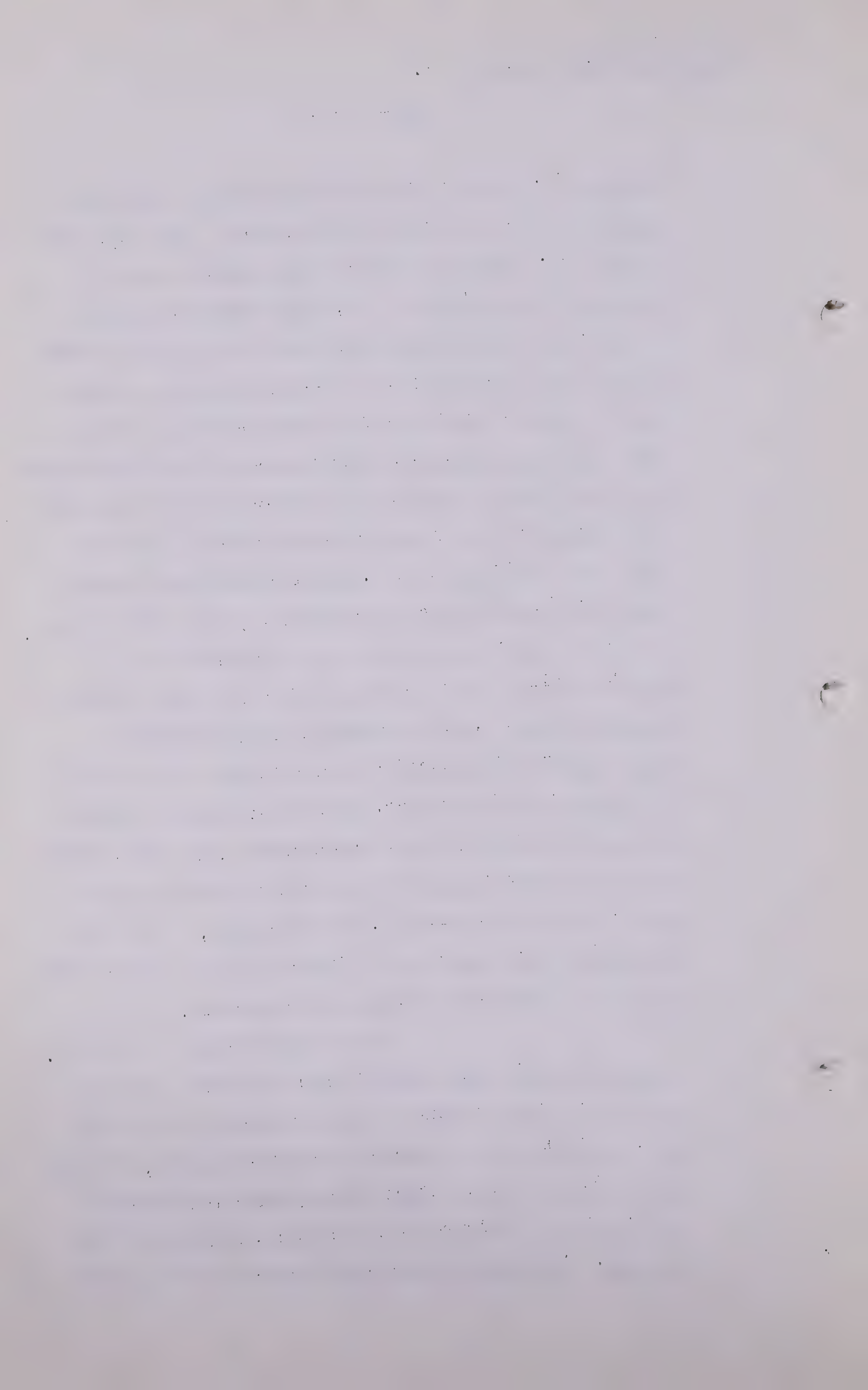
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present. In recent years the Turner Valley field has produced in the order of 8 billion feet a year from the gas cap. We estimated that such procedure would be continued for three years, it would increase slightly in 1954, and increase from there on. Now, that increase was arrived at by applying -- adding together columns 2 and 3 to give column 4 for the years of 1951, 1952 and 1953. On those assumptions the amount of gas from Turner Valley will show a continuous decrease provided no additional amount of gas over and above recent history is taken out of the gas cap. In 1954 we decided somewhat arbitrarily that perhaps reasonably, I hope reasonably, we would attempt to stabilize the total take from Turner Valley for as long a period as we could without further decline, which resulted in the subsequent fixed years of production at a total from the field of 32 billion feet per year. That then brings us through 1959 and according to our calculations, 1960 and thereon the field will be unable to maintain 32 billion feet a year, and we then allowed, or I will say, we took the production from there on as indicated by the performance of the oil reservoir and the gas reservoir.

I may turn back now to page 2.

I think you will have established the reason for the selection of the volumes of gas produced from the gas cap, estimated to be produced from the gas cap, for the period 1951 to 1959, which built production from the gas cap up to a figure of 19 billion 300 million feet in 1959. According to our calculations at that point



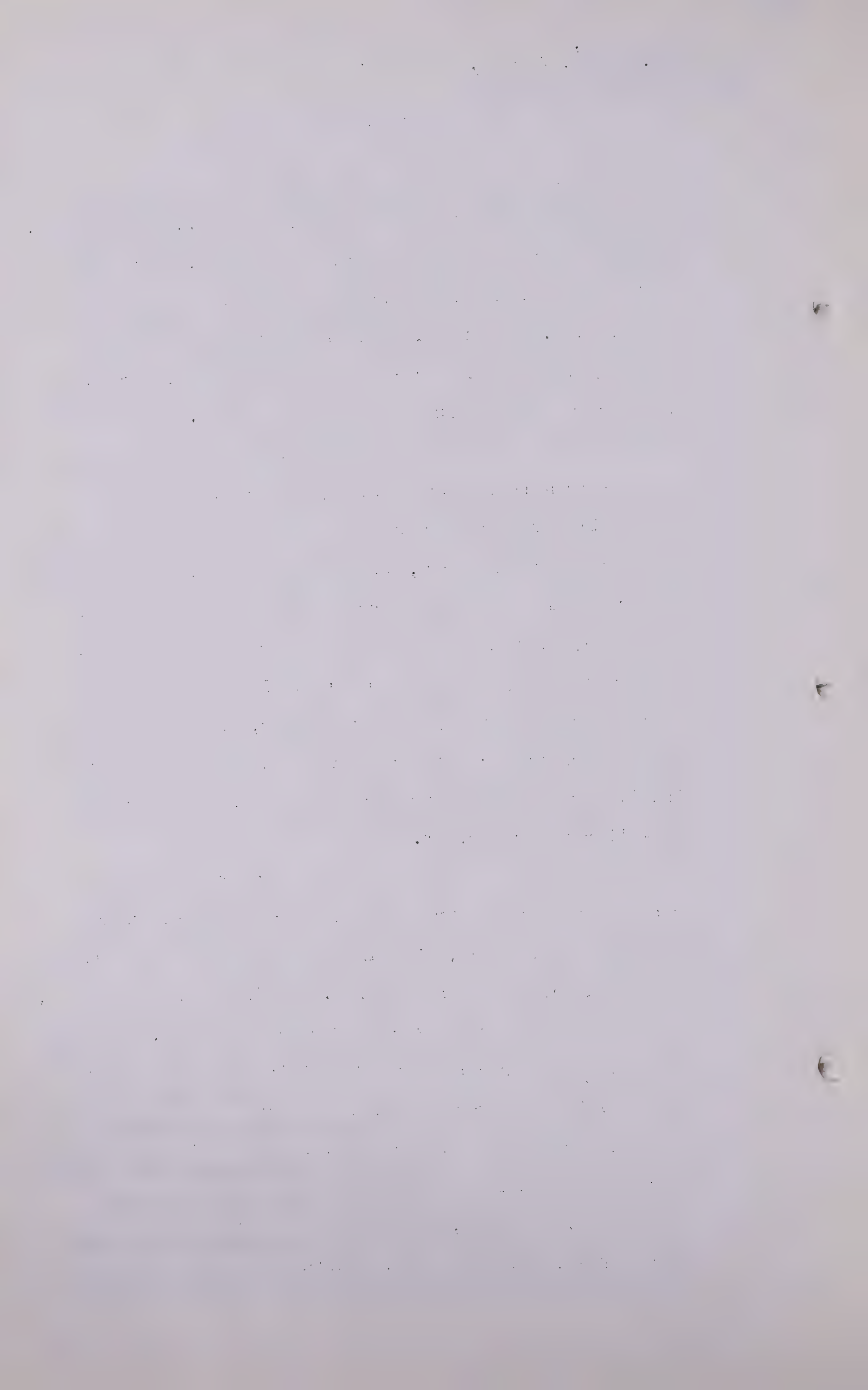
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Turner Valley would no longer be able to maintain an output of 32 billion feet per year in total, and in fact, decline is indicated in column 3 of page 2, then represents essentially the decline in ability to produce of the gas cap. Other than that I might comment on the peak day volumes in per cent of total open flow capacity and perhaps on the number of wells as well.

By our count there are 95 gas wells currently in Turner Valley gas cap. In the statistics available there seemed to be some discrepancies as to what is a gas cap, as to whether it was a well which was originally in the gas cap or whether it was a well originally in the oil sands and later gone to gas. We differentiate by saying that gas wells are only those wells which originally were gas wells, and feel that the wells which produce at a high ratio now but which originally were oil wells properly belong in our so-called gas-oil ratio reservoir.

In order to meet the demands proposed it is necessary to drill a considerable number of wells and in fact, 57 wells are proposed to be drilled in the gas cap at Turner Valley. It is my understanding, and I do not know the exact reference for this, but that in view of the abandonment of certain gas wells in the Turner Valley gas cap agreement was made some time before with the Crown that if necessary replacement wells would be drilled as and if required to meet the necessary production. However, regardless of whether or not that is the fact, well drilling, spacing, the distribution



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of wells within the gas cap at Turner Valley is not much good. It is concentrated with high density and localized areas and I think for the good of the reservoir and effective drainage in future additional wells would be required. As I mentioned, we have estimated the completion of an additional 57 wells in the gas cap in order to produce it.

Q THE CHAIRMAN: Is that figuring on a pattern of 2 cents per 1000 feet of recoverable gas?

A Oh, I think that would cover that in good shape. I have not got that calculation myself.

Q What area were you using to each well on that?

A That is what I am afraid I will have to look up. I do not recall the figures. If I remember correctly, and I perhaps should not trust to my memory, the area of the gas cap is some 10,000 acres. I do not immediately find a reference to that here. I think that value has been well established. It is a question I do not know at the moment. You will bear with me a minute?

Q You can give us the information tomorrow if you would like to take some time to look it up.

A If I may, I would prefer that.

Q I would like to hear you on both angles, the 2 cents per 1,000 and the idea of draining the acreage for oil.

A Certainly I will. I believe that generally describes the method used in Turner Valley.

Q MR. PORTER: I think you should explain. You have gone into that because it is different from the method you used in the other cases?

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A That is correct. That is the reason I did go into Turner Valley, because of the difference in the method. We tried to make a job which took into account both the dissolved gas production and the gas cap production and put those together in the total and, in fact, inter-relate those figures. The main control was the estimated gas to be produced from the oil wells and then the production from the gas cap was knitted into that or added to that in order to provide the field total.

Q THE CHAIRMAN: Were the present processing facilities taken into consideration in estimating the annual production?

A We made no particular well-to-well attempt to do that. However, if I may point out in that regard that in 1950 the field produced more gas than we have proposed in any future year, I believe.

Q 36 billion estimated annual production?

A 36 billion 700 million. Now, that is the total field, not the gas cap, and I do not recall, I will have to check a record to see how much Turner Valley produced in 1950, but it is my remembrance it is very much that order of magnitude.

Q And your estimated net annual would be gas available for sale, according to your category, 22 billion 600 million?

A That is correct. The losses in Turner Valley are extremely high, service losses. We examined the trend of those losses for the past several years and decided that a 38 per cent loss factor should be adequate for the future. As I recall, the average losses averaged

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from 35 to 40 per cent in the last two years. I presume it will go higher in the oil band perhaps in the future, I am not sure of that. It would appear that might be the direction. On the other hand, when additional gas is produced from the gas cap, why the total average loss should definitely not exceed 38 per cent in our opinion.

Q What I am getting at, if you have a low load factor at the present time you have got limited processing facilities. Had you taken into consideration the processing facilities or just to get production you have estimated what amount the building of additional processing facilities would be?

A I did not make that calculation. However, these figures were based on total annual production. I do not know whether at a 45 per cent load factor there are sufficient facilities or not.

Q As you are aware, the gas cap is used now to supplement the gas produced with the oil?

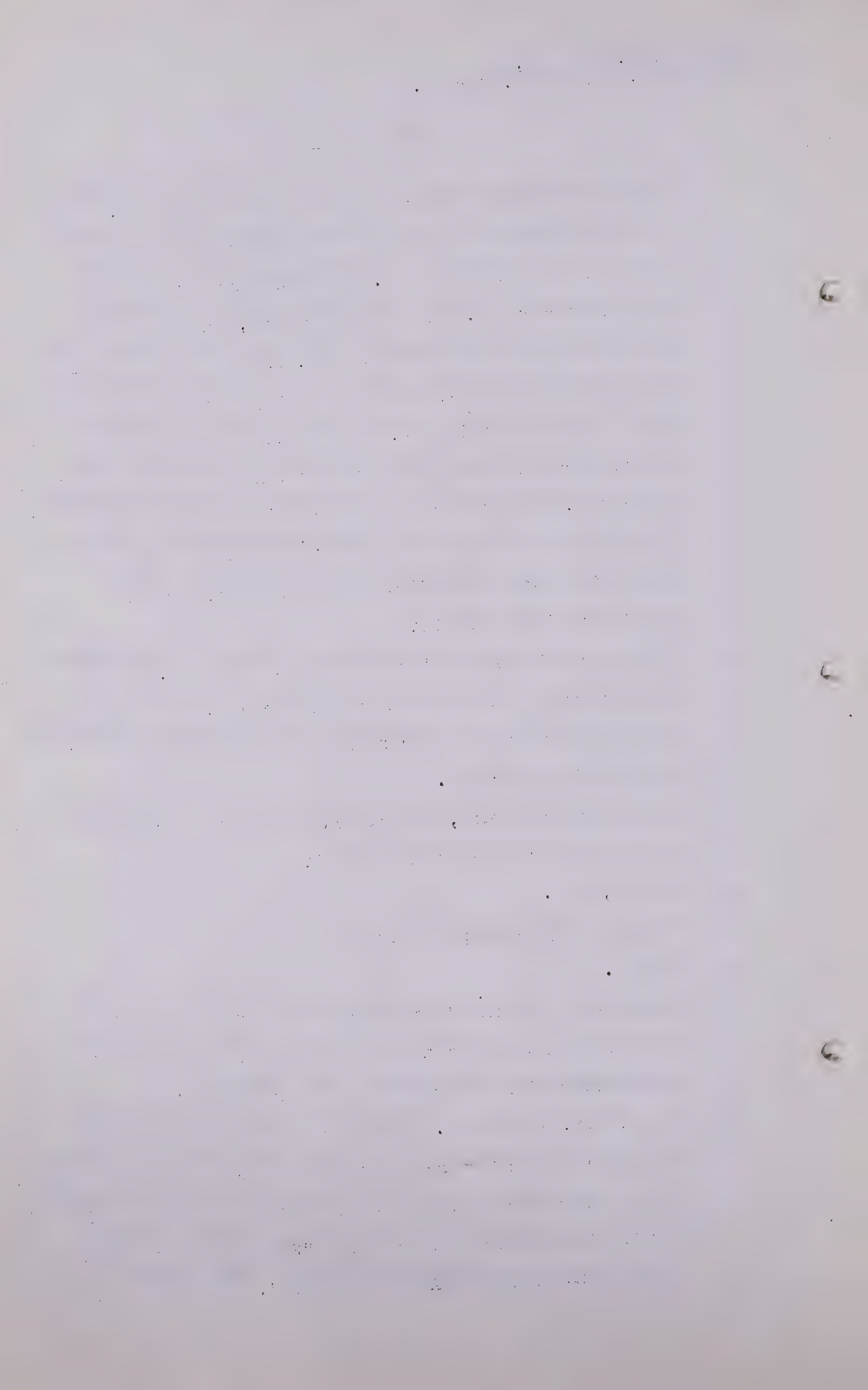
A Yes, sir.

Q To meet peak requirements?

A Yes.

Q There is a limit to the processing facilities in the field and I just wondered if you had taken that into consideration in arriving at your figures?

A No, sir, I had not. I should like now to discuss the projected performance of the Leduc D-3 Dolomite horizon, and in particular, page 3 of census division 11, Exhibit 23. This exhibit is entitled "Projected Performance Leduc D-3 Dolomite Associated Gas". The approach to



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our estimate on the projection of gas from the D-3 gas cap was based on an estimate of the future performance of the D-3 oil horizon. We have made a projection of future oil production which we believe is reasonable, and from that projection believe that by 1971 the oil column will be so thin, the remaining oil column as a result of water encroachment, that it will be impractical to prevent production of gas from the gas cap on an operating basis. As a matter of fact, we estimate that the gas-oil ratio of the oil production will increase somewhat before 1971 as a result of difficulties in preventing gas cap gas from being produced with the oil. However, we feel that in 1971 it is reasonable to presume that it will be possible to start production of the D-3 gas cap. I believe the assumptions are pretty well set up in this tabulation. I do not know if I need go into them or not. We believe that the wells will be already drilled, it will be perforated in the gas cap, will have 100 producible wells in 1951, the number will increase until 1975. We have a total of 300 wells producing from the gas cap. These wells will not be new wells, they will be old D-3 oil wells.

Q DR. GOVIER: Mr. Trostel, what did you use as an initial open flow for an average well?

A We used 15 million a day, sir.

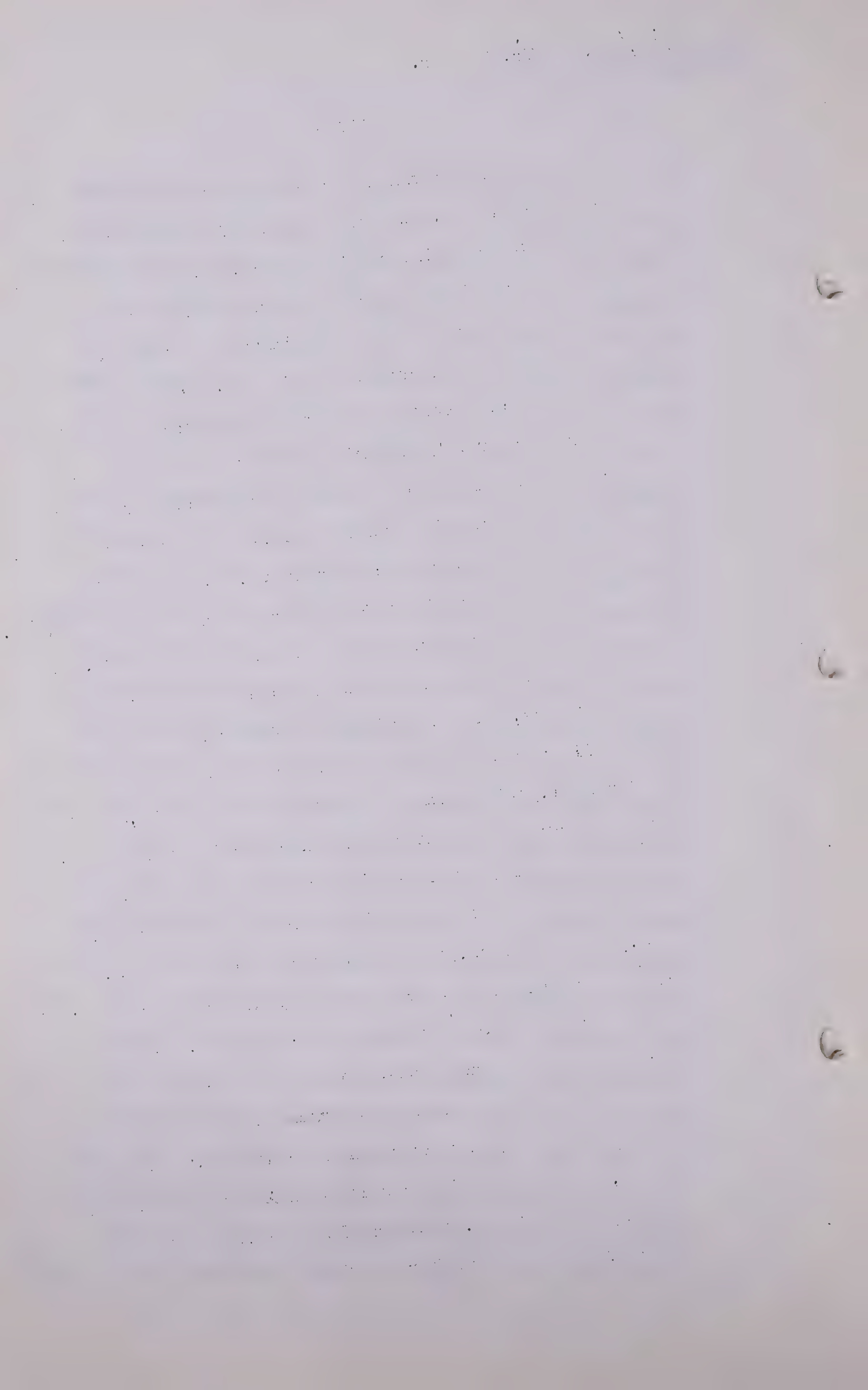
Q What was the figure based on?

A The few test data that we had. Of course, in completing wells to date the attempt was not to make gas wells but to make oil wells, and as a result, we do not have what

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we would call dependable data on tests of what the gas section could do. We have had drill stem tests in the order of 2 or 3 billion feet a day, but we then attempted to make some kind of a comparison on an average oil potential of some 800 to 1000 barrels per day and an average net pay thickness of 26 feet. We figured that with a gas cap having an average net thickness of 65 feet and presumably a similar permeability that the average gas well would be an extremely substantial well and we feel that the estimate of 15 billion a day for an average well should be conservative. We do not have factual data on what 65 feet of gas horizon will produce. I might say that we also used an exponent N of .85, which was also estimated based purely on experience in other fields, but on that basis of 15 billion per day 100 wells and a pressure of only 15 or 16 shown in column 8 for 1971, 1570 being the estimate as of 1970, we find at the year end we should have a capacity of some - - it looks awfully high -- billion feet a day, and at the rates proposed for production starting out with 66,600 Mcf. a daily gross, that would represent only a 5.5 per cent of wellhead open flow capacity under an 85 per cent load factor. That is taken from column 16. We have increased the average daily take over a 5-year period starting on a net basis of 50 million a day net to 100 million a day net as shown in column 5. This, of course, is the one with reserves in Alberta presently known, well defined, that should be able to provide available gas at a high rate with certainty some 20 years



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from now, and we have taken advantage of it in the manner shown in so far as estimating production. I might add a couple of more figures that do not appear in this tabulation, being noted on column 4 that a punitive gross gas production of 423 billion 420 million cubic feet is proposed to be produced in the period 1971 through 1980. However, and it is not shown on this particular chart, we also estimate that some 6 billion 895 million feet of original gas cap gas will be produced from the oil well prior to the time in which a definite attempt is made to produce it from the gas cap. That is the amount of gas which I mentioned earlier we estimate will result from the inability of the operators to entirely exclude all gas-cap production as the oil column thins due to the encroachment of water. In effect, then, we will produce a gross over the 30-year period of 430 billion 315 million cubic feet of gas from the gas cap on a net basis after an allowance for shrinkage, compression and so forth of 25%. That net will be 325 billion 085 million cubic feet, which represents then 76.1 per cent of the 438 billion 480 million figure which is our reserve estimate for the gas available for sale from the D-3 gas cap. That is, about 25 per cent of the gas-cap gas will still remain in the D-3 gas cap 30 years from now according to the schedule.

I should now like to talk about the D-1 horizon in the Golden Spike field.

Q DR. GOVIER: Mr. Trostel, just before you leave this present field, I wonder if you would look at

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column 6 of page 4. Am I right in interpreting that column as being the total residue gas available on a daily average basis from the Leduc-Woodbend field?

A Not available for sale, no. Those are gross figures prior to shrinkage in column 4.

Q It says "net gas".

A In column 4?

Q I am sorry, column 6, page 4.

A I misunderstood you. You are correct, yes, that is what we estimate.

Q I was just wondering, Mr. Trostel, if without considering all of the details involved, if on scanning those figures you think they reflect a realistic gas production in view of the investment of a plant and gathering facilities in that field? I am thinking particularly of the period in the late 1960's when the volumes drop to such a small value.

A In that regard I do not believe it would be reasonable to withdraw greater volumes of gas from the D-3 gas cap unless it were decided to perhaps augment the pressure by water injection. That is, on a total over-all operation it might be well with a good market, it might be good business to produce from the gas cap on a greater basis, a greater take than has been estimated here, and hold up the pressure by water injection. The economics of that would, of course, involve quite a study.

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Q If I were to tell you, Mr. Trostel, that the facilities upon which the Doctor is speaking have a bonus accelerated depreciation rate, if my memory is right, which might be more than adequate in the Sixties to have retired them completely, would that change your view?

A Are you asking me?

Q Yes? I am making an assumption.

A Would you repeat that assumption? Would you mind reading that back to me?

Q MR. C. E. SMITH: I think you can say "Yes" the way the question was put, Mr. Trostel.

A Yes, thank you. Would you read the question, please, to me?

BY THE REPORTER: "If I were to tell you, Mr. Trostel, that the facilities upon which the Doctor is speaking have a bonus accelerated depreciation rate, if my memory is right, which might be more than adequate in the Sixties to have retired them completely, would that change your view?"

A Certainly, the volume of gas in the reservoir, I will change that, the value of the volume of gas, having regard to that, I would certainly think that under the assumptions of the question Mr. Porter put, that it would definitely be worthwhile to make a larger capital investment. However, returning to Dr. Govier's question a while back, I believe this is just the D-3 that we are talking about on page 4, I do not believe that we have a summary shown here of gas, total gas production....

Q DR. GOVIER: Is there a sheet for the D-2, Mr. Trostel?

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A I will have to find where that is. I believe that is in combination with something else, a composite sheet. Just a minute, sir.

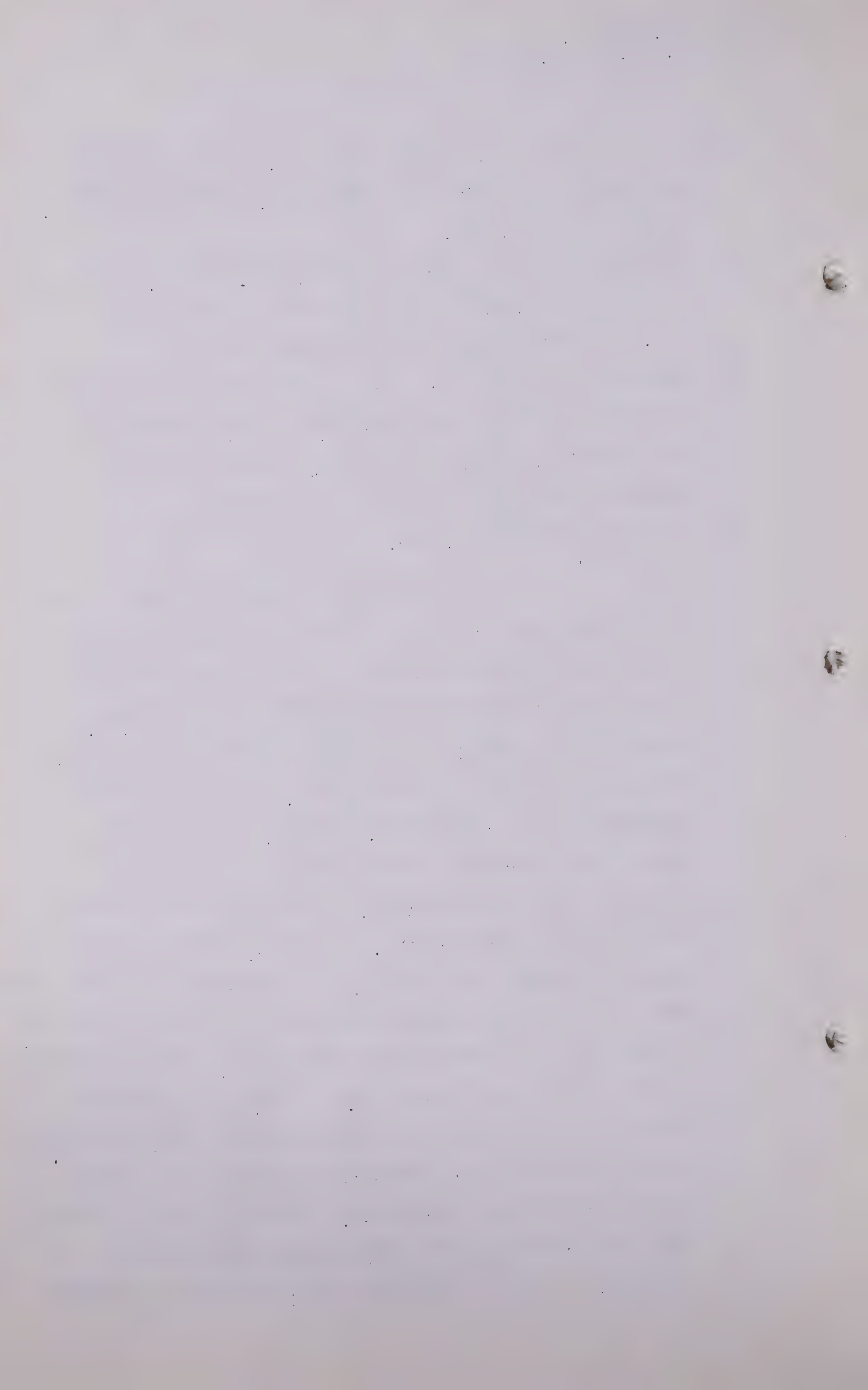
Q You might go into that tomorrow, Mr. Trostel, if you would prefer, and if you have notes to check?

A O.K. It will probably save a little time.

Q Perhaps you would care at the same time to look at the projection offered the Board by Mr. Dixon earlier in the Hearing, and my recollection is that that is a maximum about where you have a minimum?

A I will look at that, sir.

I should now like to refer to page 2 of Census Division 11 of Exhibit 23, which is a composite projected performance of the Big Lake and Golden Spike Fields' Cretaceous and Wabamun D-1 reservoirs. I might mention this is a departure from what was shown in Volume 3 in regard to Golden Spike, that is Exhibit 10, although it does not appear, perhaps, quite directly, but in our figure of some 460 billion feet of gas, deferred from oil production, we have had included some 22 billion for Golden Spike. However, when we got to making deliverability studies, we re-reviewed that situation, and it is that the prudent thing that an operator would do, providing he had a market for sale of gas, would probably be to produce that D-1 gas cap. Now, our previous thinking and understanding was that we had deferred that. It is a non-associated reservoir for possible use for pressure maintenance of the D-3. However, with a market and a value placed on the gas, an entirely separate reservoir, it was our thinking that it would be probably



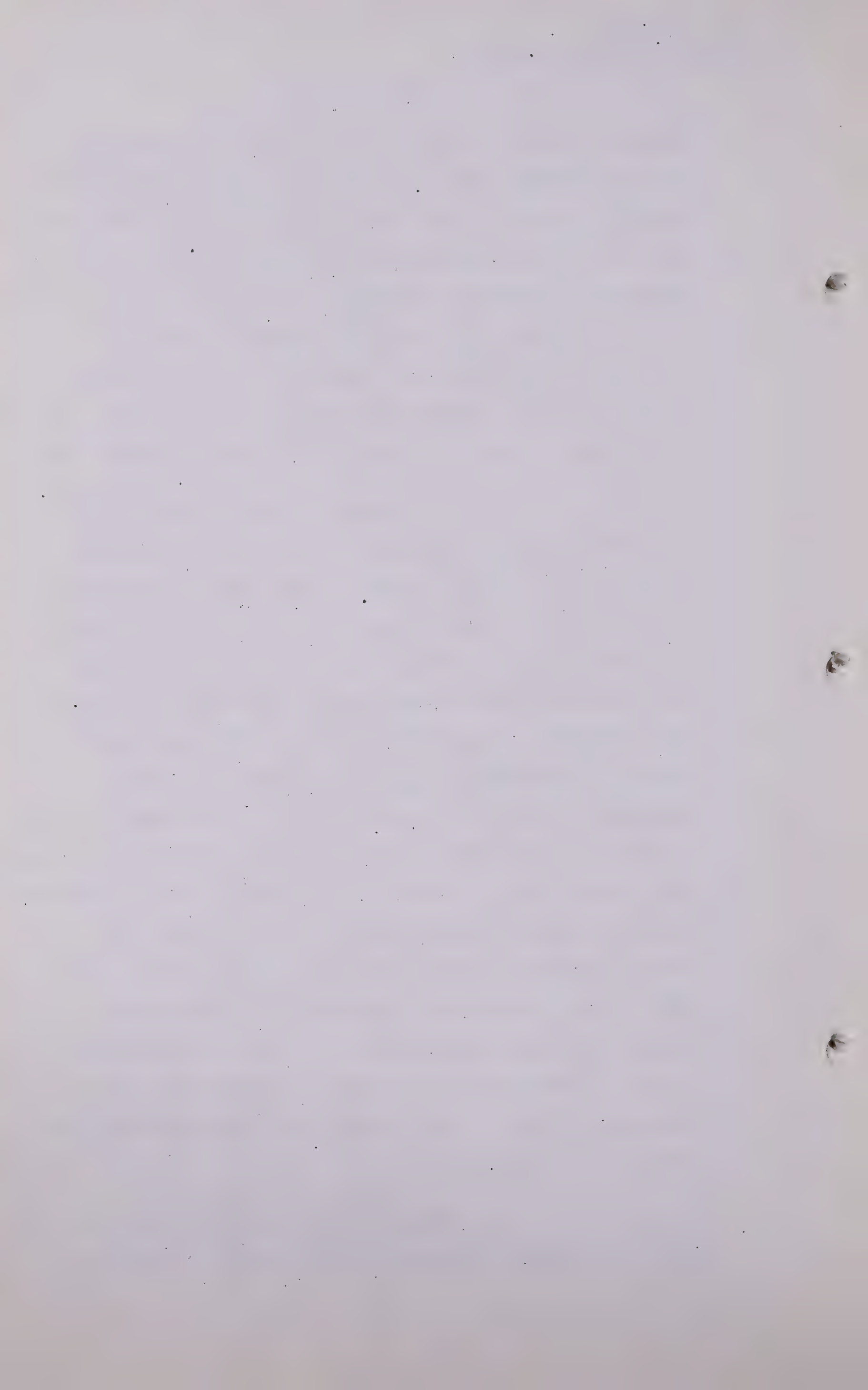
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more realistic to assume that we might use water for pressure maintenance. I understand that is being considered somewhat in the case of Redwater, and as the gas has a definite, finite value, it would be fair for the operators to receive a return, and, consequently, we then have built a projected performance schedule for the D-1 gas reservoir in Golden Spike, and it appears as part of this composite performance schedule with Big Lake, which is page 2 of Census Division 11, Exhibit 23.

I should like now to refer to the page which appears behind the tab entitled "Provincial Availability", in Exhibit 23. This particular tabulation is a summation of all of the data, or all of the performance projections which are presented in evidence here. They indicate that according to the assumptions that we have made for a reasonable development program, what we think is a reasonable production program, with that reasonable production program, that over the next 30 years it should be possible to produce some 6 trillion 562 billion, 907 million cubic feet of net pipe line gas. This particular schedule here is merely illustrative of what we feel could be done, not what we suggest should be done. This work to date, in effect, has provided a framework of mathematics upon which which we can then calculate the effect of making any other lower withdrawal than that proposed, or, let us say, within that, or other than that summarized in Volume 4.

Now, I should like to refer, if I might, to Exhibit 25, Exhibit 25A, I mean. I wish to



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refer to the Table entitled "Projected Net Pipe-line Gas Production". Columns 2, 3 and 4 are figures representing the calculations referred to in Volume 4. It gives the total Province availability, according to the various assumptions for development and production which we have made on a field-by-field basis. As I said before, and I wish to repeat again, this is the framework on which we can calculate to meet any other given set of conditions on a total-province basis. Now, the reason we could do that is this: The available rate at which we can produce or one can produce a particular reservoir or field, is a function subsequent to development of the amount of gas that you take out from that field. Actually it is a direct function of the remaining pressure of the field. As a matter of fact, that may not be linear, but it varies directly with and is a direct function with regard to it. That is, as you take gas from a field, the pressure drops. Corresponding to that reduced pressure, there is a corresponding rate of availability and production, and as more gas is taken out of a reservoir, the pressure drops further, and the rate of production declines. Now, if we would wish to set out on a Table the total basis of what we wished to take out of the Province, and we have built a framework of what the Province could do in total within that. According to the assumptions we have made, it is possible to take out a lesser amount than that at any time and be able to compute the availability capacity to produce at that time. Accordingly, we have on this tabulation a re-estimate of the actual use, or an estimate of what might be produced during the next

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30 years if we have only available for production those fields, that those reserves now known, are now known to exceed.

Q MR. PORTER: Now contained in these reserves?

A Yes, now contained in these studies.

Q In these studies?

A Yes.

Q There may be some that we know to exist that have not been contained in or that have not been estimated?

A That is correct, sir. I stand corrected. We have assumed that the figures set out in the Interim Report of the Conservation Board, as being our source of information as to the probable Provincial requirements in the future. These figures, taken directly from the Interim Report, appear as Columns 5, 6 and 7. These are the first requirements to be met, and on top of that we have the 5-year contract for export to Montana to consider, and consideration has been given to this export in Columns 8, 9 and 10. We then considered the requirements of the Trans-Canada Transmission, Trans-Canada Pipe Line, for export transmission in accordance with its application. We find that it proposes to build a line having a throughput capacity of 365 million cubic feet a day, operating on a load factor of 85% equivalent to 310 million cubic feet of gas a day on a 365-day basis. We have made the approximation or assumption in setting up the schedule, Column 11, that this would be the most rapid set of needs for Trans-Canada that could possibly result or would result if an export permit were given almost immediately. No gas is proposed to be taken in 1951, with construction possibilities in,

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oh, the latter part of 1952, and a small amount of gas could be taken, which would probably be just to the first connections that they would have. As the line extended through 1953, it would take an increasing amount, and at 1954 the line would be produced under rated capacity.

We then have added across and summed up, for example, Item 16, or Column 16, that is, in that Column there is a summation of 7 plus 10 plus 13, and, in fact, is an important column.

And, similarly, Column 15 results from adding Column 6 to Column 9 and Column 12. And, finally, Column 14, that column is an addition of Column 5, plus Column 8 plus Column 11.

Now, we solved this particular problem practically in a manner that seemed the simplest and a plot was made of the rate of production, Column 2 versus the cumulative production, Cooumn 4, for the Province as a whole. We then said that there should be a 1 to 1 relationship, and when so much gas has been taken out of the Province they should have a certain deliverability as shown by the average daily rate in Column 2. That can be visualized, if you like, by saying that if you wish to produce 10% less out of each field straight across the board, the pressure will drop only 90% for what you might have estimated for the first year, and, hence, the cumulative production relationship would be such that you could go to this curve and read off for the 90% take, and find the rate of availability for only 90% of the volume



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assumed to be produced in Column 2, if only 90% of the volume assumed to be produced in Column 2 were produced. There is some question in my mind now as to whether that sentence is very clear.

However, in effect, we did make this plot of Column 2 against Column 4, and then went to Column 16, the cumulative production according to the assumptions made, and read from that particular chart the corresponding rate of availability which could be produced for that total withdrawal. For example, we found that if in 1951 the production of 58.1 billion were in order, that the ability to produce for the Province as a whole would amount to 388 million feet a day.

In fact, it may be a lot easier to follow this if I may now refer to Exhibit 25 entitled "Availability and Production of Net Pipeline gas", which is merely a graphical presentation of the data shown in tabulation form on Exhibit 25A.

On that exhibit we have first set up across the bottom the requirements of Alberta, starting in 1951 at something like 15 million a day, and increasing to some 360 million a day for 1980. That is the bottom curve on this chart. We then, for the years 1951, '52, '3, '4 and '5 have plotted the rate of gas production proposed, in fact, under contract, I understand, to be exported to Montana.

Then, starting in the middle of 1952, we build up the rate of take of Trans-Canada Pipe

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Lines so that at the end of 1953, starting with 1954, Trans-Canada will produce at an average daily rate of 310 million feet a day, equivalent to 365 million feet a day for a load factor of 85%. This curve indicates that it will be possible for Trans-Canada to transport, export some - transport 310 million feet a day on the average of 365 feet a day with an 85% load factor for a period of 20 years. However, at the end of 1973 there is insufficient productive capacity to permit a continuation of Trans-Canada's export from these fields, as considered, and it is necessary then to reduce the take from Trans-Canada. As a matter of fact, in the last 6 years of 30 years, it will be getting gas from the proposed supply fields of Canada, supply fields of Trans-Canada Transmission, with some of that gas to be used to meet the Provincial requirements. This study is based again on just the amount of gas which we have estimated at the present time. No allowance has been made for new discoveries, including the ones mentioned briefly by me this morning.

However, it seems almost inescapable to me that the momentum of finding gas in Alberta cannot stop all of a sudden, and that the premise on which we are working, which is a requirement, cannot be considered to be realistic in view of the trend of finding gas in the Province.

I should like to refer, if I might, to Exhibit 24, entitled "Discovery Record of Initially Recoverable Gas Reserves." These are the gas reserves that we have estimated, and which appear in our exhibits,

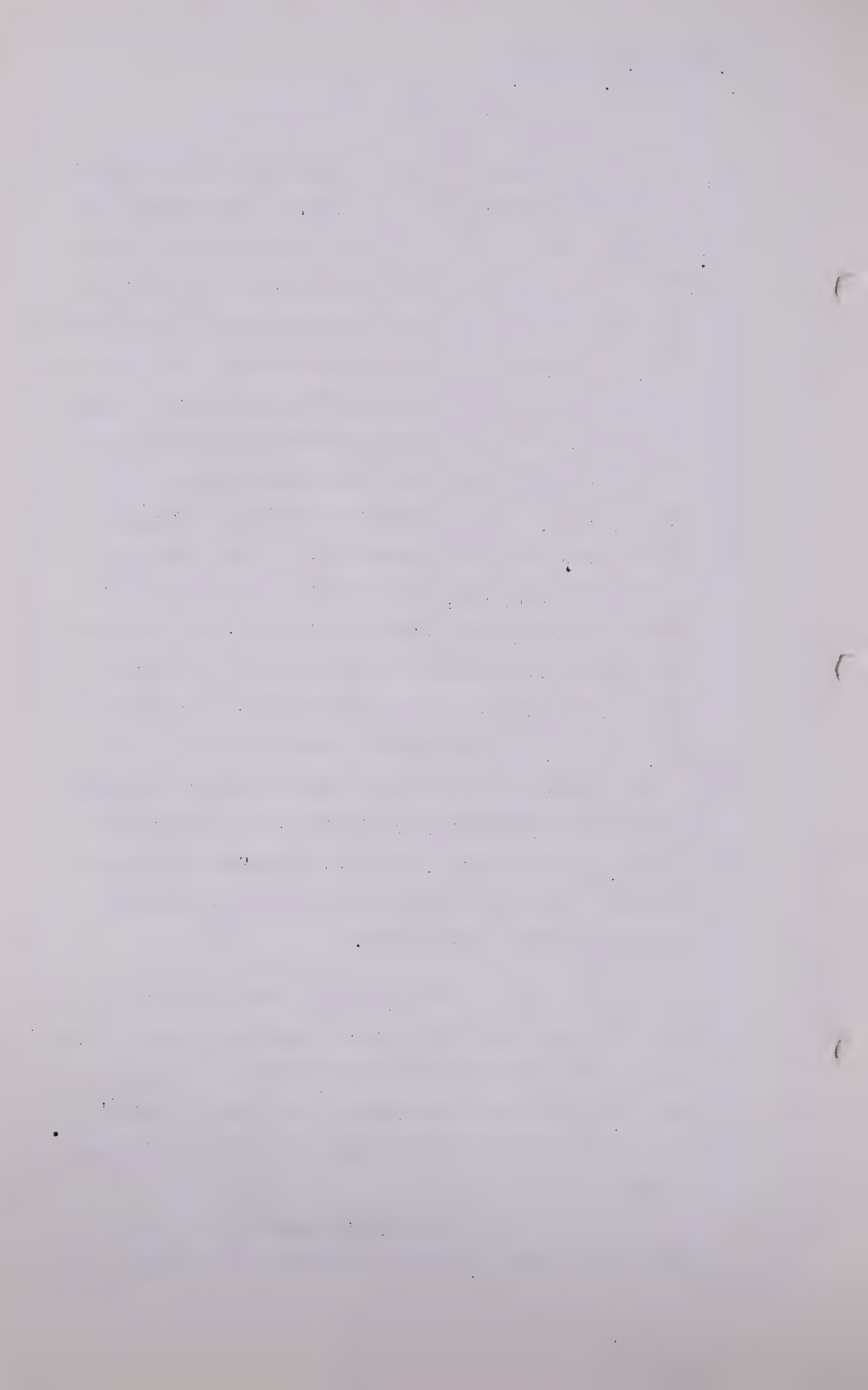
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but they have been credited to the fact of the discovery of the particular field in question. For example, in 1890, we show a reserve of some 1 trillion feet from a field that happens to be Medicine Hat. Of course, no one suspected in 1890 that a trillion feet of gas had been found. However, from data which has been developed and experience throughout the succeeding 60 years, we now estimate that the original recoverable gas reserves of the Medicine Hat field were something in excess of 1 trillion feet. It is rather interesting to examine this chart from a time standpoint. I would like to refer to the lower part now, Reserves Discovered Annually. I believe there was some minor gas in 1883, but in 1890 - I might also say that these figures at the bottom, the time figures are at the end of the year. In Medicine Hat, in 1890, very little was found, and still later, I have forgotten now what was found in 1908, and then I believe the Viking-Kinsella in 1914, about 1914, Turner Valley, the high point, in 1924, and you can hardly see the size of the intervening discoveries by yourself between the ones I am citing.

Now, we had a good discovery in 1943, and then there was Pincher Creek and Jumping Pound, and the large area of Cretaceous fields in the last 5 years, and that has contributed to the major portion of the reserves which have been found in Alberta in the past 60 years.

Now, with regard to the upper part of the chart, if I may refer to the cumulative

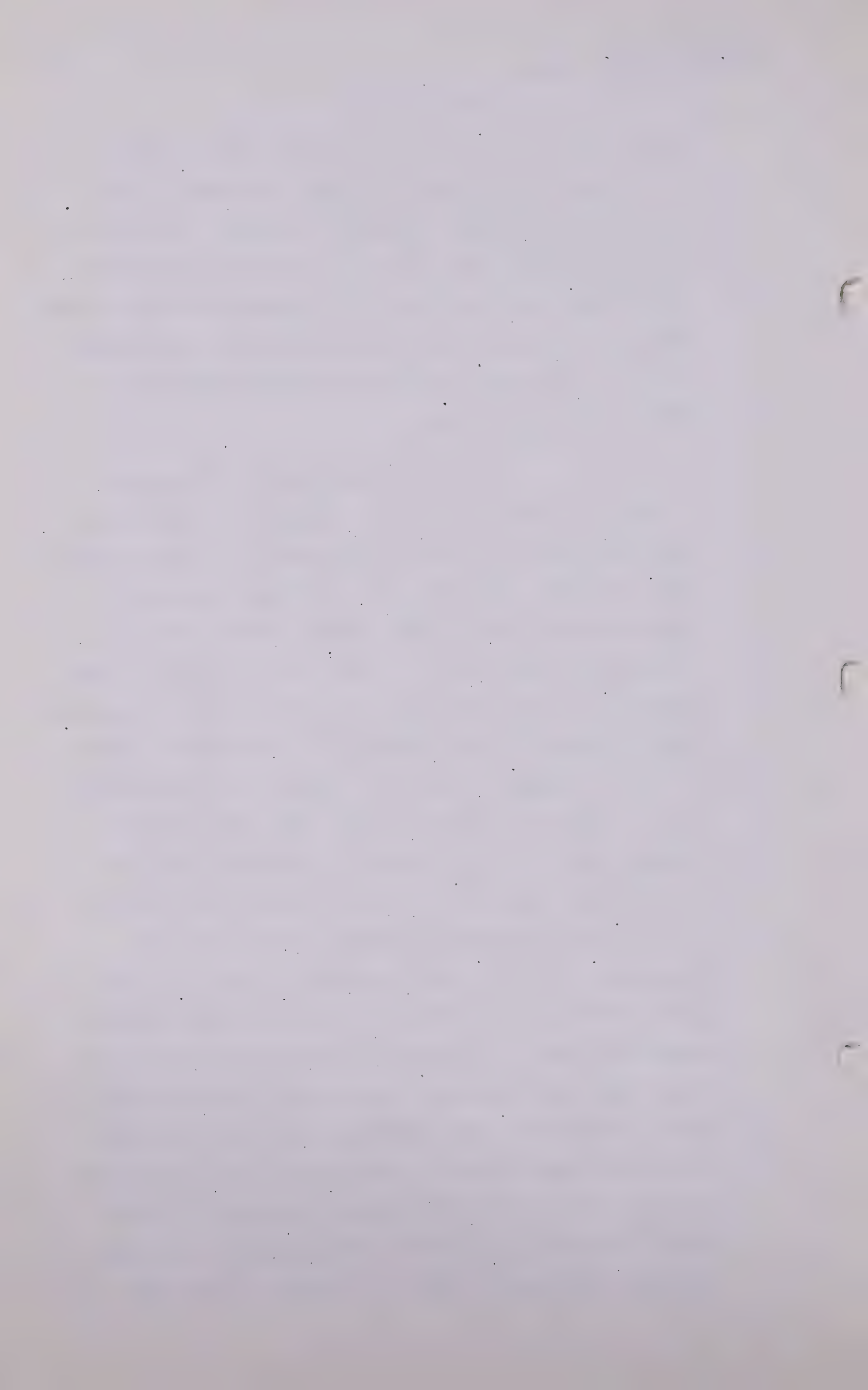


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reserves discovered, it shows a little more clearly the effect of gas found in the past few years. The chart goes essentially straight from 1900, - I am sorry, from 1890 to 1914, then from 1914 to 1924, from 1924 to almost 1945, and then from 1945 on there has been a sharp increase in the rate of discovery and of the cumulative reserves discovered, which is this particular curve to which we are referring.

The hypothesis that no gas will be found for the next 30 years is quite a conservative approach, and we can well understand why it was a requirement. However, with this trend of discovery that is indicated from 1945 to 1950, jumping from 6 trillion to nearly 13 trillion in 5 years, is a trend which must continue, as it is impossible to see how that can suddenly flatten out when at the present time exploratory effort, if not at a peak, is close to a peak in this particular area. The only thing that could cause that curve to flatten would be if the operators themselves were to lose hope of a market. In case that market does not develop, probably some flattening of that curve is indicated. However, with the incentive of a sale for gas reserves and the effort directed, perhaps, towards finding oil and gas reserves, it seems inescapable that this trend will continue. In another 10 years it is quite conceivable, very readily conceivable, that some 20 trillion feet of initial recoverable reserves may be found. I do not know the volume. However, I merely wish to make the point that discovery records and the history, particularly with the emphasis to the rate



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finding during the last 5 years, the rate of finding, resulting from the vast amount of money which has been spent in exploration effort, certainly has built up a rate of finding gas and momentum which will be continued somewhere into the future in an amount which I do not know.

Q Well, leaving aside the economic discussion and the forces that compel activity, I would like you to address yourself for a moment to the geological situation.

MR. C.E. SMITH: Will you take a look at the clock, Mr. Porter?

Q MR. PORTER: Have you any idea of the drilling density expressed in terms of square miles of the area under exploration in the total sedimentary basin, or could you get it for us by the morning?

A I could get it. I would hate to set a figure.

Q Well, let us have it in the morning, because I think it is important. Mr. Chairman, I know it has been moved by Mr. Smith that we adjourn.

THE CHAIRMAN: We will adjourn until tomorrow morning.

(Hearing adjourned until 9.30 A.M., September 25th, 1951).

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The Province of Alberta

PETROLEUM AND NATURAL GAS CONSERVATION BOARD

Application for Permission to Remove or cause to be removed
Natural Gas from the Province of Alberta, under the Provisions of the
Gas Resources Preservation Act by Western Pipe Lines.

I. N. McKinnon Esq., Chairman

D. P. Goodall Esq.

Dr. G. W. Govier

Session:

Volume_____

